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Effective diet-based interventions targeting youth at risk for developing hypertension (HTN) require understanding adolescent meal patterns and their relation to HTN. The purpose of this research was to determine usual meal patterns of African American adolescents and how these vary by gender and HTN risk status. Specific aims were: develop a method to visually represent meal patterns; describe differences in meal patterns between participants of differing genders and HTN risk categories; and explore relationships between meal patterns and systolic blood pressure (SBP), diastolic blood pressure (DBP) and body mass index (BMI).

Fifty-eight African Americans (ages 17-20, 30F) at either high- (n=29) or low-risk (n=29) of developing HTN were interviewed about their week-day eating and activities. The Diet History Questionnaire (DHQ) was used to estimate intake of select foods and nutrients associated with blood pressure (BP). Height, weight, and BP were measured. A daily timeline for each participant was constructed capturing typical food choices, eating times and locations, and activities. These Meal Pattern Timelines (MPT) were used to compare proportions of healthful, moderately healthful, unhealthful, and skipped meals, snacks, and beverages across groups. Meal patterns were identified and each participant categorized as either reporting a meal pattern or not. Meal patterns related to DHQ measures ($p<0.05$) were selected for principal components/factor analysis. Step-wise regression models related the final factor solution to SBP, DBP, and BMI.

Overall, low-risk participants consumed fewer unhealthful dinners, snacks, and beverages than high-risk groups. Twenty meal patterns identified from the MPTs provided a six-factor solution (*Healthy Dinner, Healthy Lunch, Unhealthy Snacks, Skipped Breakfast, Unhealthy Beverages, Healthy Snacks).* SBP increased with higher factor scores for *Unhealthy Snacks* and *Unhealthy Beverages* and lower scores for *Healthy Lunch* and *Skipped Breakfast* ($p=0.03, R^2=0.18$). BMI increased with lower scores for *Healthy Dinner* and *Skipped Breakfast* ($p=0.05, R^2=0.10$). *Unhealthy Beverages* and *Unhealthy Snacks* trended toward a positive association with DBP ($p=0.07, R^2=0.09$).

The MPT technique was able to identify and distinguish the meal patterns of different groups of African American adolescents. This novel approach can be further developed for nutrition assessment and counseling as well as for future dietary intervention with African American adolescents.

DIFFERENCES IN MEAL PATTERNS OF AFRICAN AMERICAN ADOLESCENTS OF VARIED HYPERTENSION RISK

by

Tara L. Flint

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To Kurt, a Survivor

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of The Graduate School at the University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

Overview

Nearly one in every three adults in the United States is afflicted with hypertension (HTN), a condition that contributes to cardiovascular disease, kidney failure, ocular damage, and is a known risk factor for the most common cause of death in this country: heart disease.[1-5] The monetary burden of these ailments is extraordinary and that of HTN alone totals more than $60 billion yearly.[6,7] Alarmingly, the prevalence of HTN has steadily increased since the 1980s[8,9] and has been documented in youth populations as high as 8%.[10-15]

HTN disproportionately affects African Americans.[1,16,17] Compared to whites, African Americans develop HTN more frequently, and often with greater severity and more serious complications.[1,16,17] These trends are evident as early as adolescence and track into adulthood.[10,18]

Of the modifiable risk factors that have been identified for HTN, diet has been one of the most extensively studied among adults. The Dietary Approaches to Stop Hypertension (DASH) clinical trial showed that a diet rich in fruits and vegetables and low-fat dairy and with reduced total and saturated fat can significantly lower blood pressure in normotensive, prehypertensive, and stage I hypertensive adults.[19] Further analysis revealed that this approach was particularly effective for African Americans.[20]

Very few studies have examined the relationship between dietary intake and HTN in youth populations. Those that have support the hypothesis that diet is an important modifiable risk factor for HTN for youth, just as it is for adults.[21-23] While there is a clear need for diet-based HTN prevention programs targeted at youth, none currently exist. Before such interventions can be developed, an in-depth understanding of adolescent meal patterns and their relation to HTN is needed.

This project provided an understanding of the usual meal patterns of adolescent African American males and females of varying HTN risk. Aims included developing a systematic method to capture a visual representation of the usual meal patterns of participants, describing the differences in meal patterns between those of differing genders and HTN risk categories, and identifying meal patterns that are related to clinical outcome measures.

Explanation of the Problem

HTN, commonly known as high blood pressure, is characterized by persistently elevated arterial blood pressure, the force exerted by the blood on the inner walls of the arteries.[24] For adults, HTN is defined as systolic blood pressure (SBP) equal to 140 mmHg or above *or* diastolic blood pressure (DBP) equal to 90 mmHg or above,[1] where SBP is the maximum pressure attained during ventricular contraction of the heart and DBP is the minimum pressure experienced during ventricular diastole.[24] For children and adolescents, HTN is defined as SBP *or* DBP greater than or equal to the 95th percentile for gender, age, and height.[25]

In the United States, the prevalence of HTN has steadily increased since the 1980s.[8,9] Today nearly one of every three persons above the age of 20 is afflicted with HTN, equating to roughly 72 million Americans; only 35% have their HTN under control.[1] The prevalence among youth has been reported between 0.76% and 8.1%,[10-15] and may be underdiagnosed.[15]

African Americans develop HTN more frequently than whites and tend to do so earlier in life.[1,16,17] Severity is often greater and complications are likely to be more serious; the death rate from HTN for African Americans is more than twice that of whites.[1,16,17] Additionally, the percentage of African Americans who have their HTN under control is lower compared to whites.[1,16] These trends may emerge as early as adolescence.[10] McNiece et al. found African American race to be an independent predictor of prehypertension among 11-17 year olds in Houston public schools.[10] In addition, the Bogalusa Heart Study reported a significantly greater prevalence of HTN among African American adolescents compared to white counterparts.[18]

Preventing HTN is important because heart disease is the most common cause of death in the United States[3] and HTN is a known risk factor for cardiovascular diseases (CVD) including atherosclerosis, coronary artery disease, coronary heart disease, heart failure, heart attack, and stroke.[2,4,5] The monetary burden of CVD on the United States is enormous. Direct costs of hospitalizations, nursing homes, and medical care combined with indirect costs of lost productivity due to morbidity and mortality totaled greater than $400 billion in 2006, $63.3 billion of which was derived from hypertensive disease alone.[6,7] Furthermore, uncontrolled HTN can also lead to kidney failure and damage to

retinal vasculature.[2,4,5] Although the consequences of HTN are seen less frequently in youth, left ventricular hypertrophy has been documented in 55% of hypertensive children examined in a study by Daniels et al.[26] Research indicates that elevated BP in childhood and adolescence appears to track into adulthood and correlates with increased risk of CVD,[27,28] suggesting that in order to reduce the prevalence and burden of adult HTN and CVD, prevention strategies targeted at youth are needed.

A number of risk factors have been identified which may contribute to the onset of HTN. Uncontrollable risk factors include African American race, male sex, and advancing age.[29] Controllable risk factors include overweight and obesity, sedentary lifestyle, stress, excess alcohol consumption, and a diet lacking fruits and vegetables and high in calories, fat, and sodium.[29] Because HTN is a lifelong disease which can be controlled but not cured, the best approach to primary and secondary prevention of HTN is through modification of these risk factors.[5,30,31]

Dietary modification has been one of the most studied approaches to reducing HTN among adults. The most successful dietary HTN intervention to date is the landmark DASH clinical trial conducted by Appel et al., which began in 1994.[19] Four hundred fifty-nine adults (22 years of age or older) with SBP below 160 mmHg and DBP between 80-95 mmHg who were not taking antihypertensive medication completed three phases of the trial. The initial phase consisted of three separate BP screenings to ensure that participants met inclusion criteria. The second phase lasted for three weeks during which all participants consumed the control diet (low in fruits, vegetables, and dairy, and fat content representative of the typical American diet). At the end of phase two, BP was

measured again and participants were randomly assigned to one of three diets for the third, intervention phase of the trial that lasted eight weeks, during which BP was measured weekly. Those in the control group maintained the control diet. The fruits and vegetables diet provided 8-10 servings of fruits and vegetables daily as well as higher levels of potassium, magnesium, and fiber than the control diet. The combination diet provided that which the fruits and vegetables diet did as well as three servings of low-fat dairy, higher calcium, and reduced total fat, saturated fat, and cholesterol. The sodium content of all three diets was comparable at roughly 3,000 mg/d. Although both the fruits and vegetable diet and the combination diet resulted in significantly decreased SBP and DBP compared to the control diet, the reductions seen in those on the combination diet were significantly greater than those on the fruits and vegetables diet. These reductions were achieved after two weeks and sustained through the entirety of the study.

In 1999, Svetkey et al. reexamined the data from the DASH randomized clinical trial in a subgroup analysis by race, hypertensive status, sex, weight status, age, educational level, physical activity level, family income, and alcohol intake.[20] The authors concluded that the combination diet lowered BP in all subgroups examined and was particularly effective for African Americans.

More recently in 2001, Sacks et al. conducted a three and a half month randomized trial of crossover design to examine the effects of three levels of sodium restriction in a control diet verses the DASH diet.[32] In both diet groups, the low sodium intake level lowered BP to a significantly greater degree than the medium sodium intake level, which lowered BP to a significantly greater degree than the high sodium intake

level. However, at each sodium level, greater reductions in BP were seen in those participants on the DASH diet compared to those eating the control diet.

These results clearly demonstrate that a diet rich in fruits, vegetables, and low-fat dairy and with reduced saturated and total fat can significantly lower BP in normotensive, prehypertensive, and stage I hypertensive adults, regardless of sodium intake.[19] However, restricting sodium intake in combination with the DASH diet may result in further BP decreases.[32] Finally, African Americans may stand to benefit the most from making such dietary changes.[20]

Dietary modification among youth aimed at preventing or reducing HTN has not been as extensively researched. Only three studies to date have explored the relationship between diet and BP in youth.[21-23] In 2005, Moore et al. reviewed eight years of follow-up data from 95 children (3-6 years of age at enrollment) in the prospective Framingham Children's Study which began in 1986.[21] Participants underwent yearly BP measurements and dietary assessments (via 3-day food records) and were classified according to servings of fruits and vegetables and dairy consumed per day into one of four groups: 1) low fruit and vegetable (< 4 svgs/d) plus low dairy (<2 svgs/d), 2) low fruit and vegetable plus high dairy (≥2 svgs/d), 3) high fruit and vegetable (≥4 svgs/d) plus low dairy, or 4) high fruit and vegetable plus high dairy. At enrollment there were no significant differences in SBP or DBP between the groups. However, significant differences in yearly BP changes were apparent. Children in groups 2 and 3 displayed smaller yearly increases in SBP than those in group 1. Children in group 4 exhibited smaller increments in SBP and DBP than all other groups. By early adolescence, average SBP of those in

groups 2 and 3 was 4 mmHg lower than those in group 1. Average SBP of those in group 4 (106 mmHg) was nearly 7.5 mmHg lower than that of those in group 1 (113 mmHg). Although the results for DBP did not reach significance, trends were similar to those found for SBP. This is the first study documenting a possible beneficial effect of the consumption of fruits, vegetables, and dairy on BP in a youth population, and is consistent with findings in adults from the DASH trial.

In 2000, Falkner et al. examined the nutrient intake of 14-16 year-old adolescents at high risk for HTN (BP at or greater than the 90th percentile on two occasions).[22] Participants (79% African American) completed 24-hour dietary recalls and were then classified based on high or low folic acid intake, a proxy for fruit and vegetable intake. Average DBP was significantly higher in the low folate group (74 mmHg) as compared to the high folate group (70 mmHg). In addition, those in the low folate group had significantly greater daily energy and sodium intakes and lower daily intakes of potassium, calcium, and magnesium. This study provides evidence that dietary patterns may contribute to BP levels among adolescents at high risk for HTN.

Finally, in 2004, D'Addesa et al. compared the dietary intake of hypertensive and normotensive Italian adolescents (n=286).[23] Diet was assessed via 24-hour dietary recalls and food records. Participants were considered hypertensive if BP was at or above the 90th percentile for age and gender. The mean daily intake of energy, macronutrients, and cholesterol was greater among the hypertensive teens, although not statistically significant. No significant differences were found in micronutrient intake between the

two groups. Data trended towards a greater consumption of meat, ham, salami, cheese, and fish among the hypertensive adolescents as compared to normotensive counterparts.

All three studies that have investigated the relationship between diet and HTN in youth appear to support the hypothesis that diet is an important modifiable risk factor for HTN in this age group, just as it is for adults. Combined with the ample evidence that elevated BP begins at a young age and tracks into adulthood, there is a great need for dietary HTN prevention programs targeted at youth. In order to make these relevant, an in-depth understanding of adolescent meal patterns of those at risk is crucial.

Purpose and Specific Aims

The purpose of this project was to learn the usual meal patterns of African American adolescents and determine how they vary by gender and HTN risk status.

Aim 1: Develop a systematic method to capture a visual representation of the usual meal patterns of participants (Meal Pattern Timelines [MPT]) that may be used to distinguish those of differing HTN risk profiles and also as a future tool for dietary change.

Approach: Information about daily eating was extracted from in-depth semi-structured interviews with participants to construct MPTs.

Aim 2: Describe the differences in meal patterns between those of differing genders and HTN risk categories based upon MPTs.

Approach: Descriptive statistics was used to compare the relative proportion of healthful, moderate, unhealthful, and skipped eating and drinking occasions across genders and risk categories.

Aim 3: Identify the meal patterns derived from MPTs that are related to SBP, DBP, and body mass index (BMI), regardless of gender and risk categories.

Approach: Meal pattern variables were identified from the MPTs. Participants were assigned a "1" if they definitively displayed the meal pattern variable and a "0" if they did not or it was not clear whether they did or not. One way ANOVA with JMP version 6 was used to compare the intake of components of the DASH diet of those participants who were assigned a "1" with those who were assigned a "0" for each variable. Meal patterns that yielded statistically significant differences ($p<0.05$) were retained for an exploratory principal components/factor analysis (PC/FA). Factors derived from the PC/FA were used as independent variables in step-wise models, with SBP, DBP, and BMI as the dependent variables.

This project provided a better understanding of the usual meal patterns of African American adolescents and how they vary by gender and HTN risk status. This project also identified those meal patterns related to HTN risk and clinical outcome measures in this population. These findings may be used in future diet-based HTN prevention interventions for African American adolescents.

CHAPTER II

REVIEW OF THE LITERATURE

The DASH clinical trial provided persuasive evidence that dietary modifications are an effective approach to reducing high BP among adults.[19] Parallel research has not yet been conducted in an adolescent population, though it is likely that teens at risk for early onset HTN would achieve similar benefits as adults by adopting the DASH diet. This review of literature describes what is known about adolescent eating in relation to the components of the DASH diet and examines associated meal patterns as potential targets for dietary intervention.

Fruits and Vegetables

The DASH diet contained 8-10 servings of fruits and vegetables daily, whereas the control diet contained only 3-4.[19] Among adolescents, mean consumption of fruits and vegetables has been reported from 2.1 to 3.62 servings per day.[33-37] According to the most recent results from the Youth Risk Behavior Surveillance System (YRBSS), only 20.1% of students in grades 9-12 surveyed had eaten fruits and vegetables five or more times per day in the seven days preceding the survey.[38] Furthermore, adolescent consumption of fruits and vegetables has declined between 1999 and 2004;[39] Larson et al. reported secular decreases of 0.7 and 0.4 servings per day among girls and boys, respectively, in two cohorts of high school students in Project EAT.[39]

Neumark-Sztainer et al. assessed fruit and vegetable consumption of 36,284 adolescents in grades 7-12 in Minnesota via an abbreviated food frequency questionnaire (FFQ).[40] An alarming 28% of participants reported less than daily consumption of fruit and 36% reported less than daily intake of vegetables.[40] Males and students of low socioeconomic status (SES) reported inadequate daily consumption of fruits and vegetables more often than females and students of higher SES. In addition, African American students were found to be at greatest risk for inadequate vegetable consumption, a finding which has been both replicated[36,41] and disputed.[33,35,42]

Research indicates that adolescent fruit and vegetable consumption has not only decreased over time, but also decreases longitudinally with age.[38-40,43] In 2004, Demory-Luce et al. compared the 24-hour dietary recalls of 246 young adults in the prospective Bogalusa Heart Study with previous recalls done at age 10.[43] The percentage of participants consuming fruits and vegetables was significantly greater in childhood (65% and 88.6%) than in young adulthood (30.2% and 81.3%).[43] In addition, the 2005 YRBSS reported a lower prevalence of adequate fruit and vegetable intake among 11th graders as compared to 9th graders.[38] Finally, Larson et al. assessed fruit and vegetable consumption of 1,205 teens in Project EAT with the Youth and Adolescent FFQ (YAQ) at early (middle school), middle (high school), and late (post high school) adolescence.[39] Daily intake of fruits and vegetables decreased by 0.75 servings between early and middle adolescence and by 0.6 servings between middle and late adolescence.[39]

Adolescent fruit and vegetable consumption has been linked with three meal pattern characteristics (frequency of family dinner, involvement in food preparation, and consumption of fast food), which may prove to be useful avenues for dietary intervention.

Frequency of family dinner has been positively correlated with fruit and vegetable consumption in a number of studies.[33,44-48] Gilman et al. reported that subjects who ate family dinner daily consumed an average of 0.8 more servings of fruits and vegetables per day compared to participants who ate family dinner never or some days.[47] Videon et al. found that compared to those who ate two or fewer family dinners per week, those who ate three or more were 19% less likely to report poor vegetable consumption and 22% less likely to report poor fruit intake.[44] These effects increased with frequency of family meals. Lastly, Larson et al. reported that greater frequency of family dinners at baseline was associated with greater intake of fruits and vegetables five years later.[45]

Unfortunately, many teens do not eat dinner with the family very often, as evidenced by results of three major studies that have examined family meal frequency among adolescents: Project EAT, GUTS, and ADD HEALTH.[49] Teens in Project EAT reported eating, on average, roughly four family meals per week.[45,46,50] Results from GUTS, ADD HEALTH, and the ongoing North Carolina CHAMP survey are below:

Table 1. Frequency of Family Dinner Among Adolescents

GUTS[47,51]	**Never or Some Days**	**Most Days**	**Every Day**
	16.5%	40%	43.5%
ADD HEALTH[49]	**≤ 3 per Week**	**4-5 per Week**	**6-7 per Week**
	30.5%	21.5%	48%
CHAMP[52]	**≤ 4 per Week**	**5-6 per Week**	**7 per Week**
	40.9%	24.4%	34.7%

These data indicate that although a significant number of adolescents are regularly consuming family dinner, a proportional number are doing so infrequently.

African American adolescents appear to eat family meals less often than whites.[46,48,52] The 2003 CHAMP report indicated that 19.6% of African Americans under the age of 17 ate fewer than three family dinners per week compared to 10.7% of white counterparts.[52] In a study by Neumark-Sztainer et al., a higher percentage of Black teens reported never eating a family meal in the past week compared to all other races.[53]

As with fruit and vegetable consumption, frequency of family meals among adolescents decreases longitudinally with age.[46,47,49,51,52,54-57] Fulkerson et al. found that 22.3% of 7th-9th graders reported two or fewer family meals per week compared to 39.2% of 10th-12th graders.[55] Simultaneously, 40% of the younger adolescents reported seven or more family meals per week compared to 22.4% of the older adolescents.[55] Younger adolescents in Project EAT reported eating an average of 5.7 family meals per week compared to 3.5 for older adolescents.[57] The GUTS study found similar age-related trends; the percentage of 14 year olds who ate family dinner never or sometimes was twice that of nine year olds (24% vs. 12%).[49]

Another meal pattern characteristic that has been positively linked with adolescent fruit and vegetable consumption is involvement in food preparation. Although mothers are most frequently reported as the preparers of food within the home, two recent, large, cross-sectional studies investigated adolescents' involvement.[58-60] In both cases, participants were drawn from Project EAT and food preparation habits and dietary intake were self-reported via a survey and the YAQ, respectively. The first study was done in

31 middle and high schools in Minnesota during the 1998/99 school year,[60] and the second, five years later by mail when participants were aged 18-23 years.[59] The majority of adolescents in the initial study (68.6%) reported involvement in food preparation for the dinner meal at least once during the week prior to the survey, although frequency was typically limited to one or two times per week.[60] The follow-up study found that most young adults did not prepare food or engage in food preparation activities such as buying fresh vegetables, writing grocery lists, or preparing green salad on even a weekly basis.[59]

In both studies, frequency of food preparation was positively associated with fruit and vegetable consumption.[59,60] Teens reporting involvement in food preparation seven times per week ate one-half more servings of vegetables and one-half more servings of fruit per day than those reporting no involvement.[60] In the follow-up study, 31% of young adults reporting high food preparation frequency consumed five servings of fruit and vegetables daily compared to 3% of those reporting low food preparation frequency.[59]

Both studies uncovered a striking difference between genders.[59,60] Female participants were more likely to be involved in food preparation than males and reported higher perceived adequacy of cooking skills. Males were more likely to report the use of frozen dinners and packaged convenience foods and reported lower perceived adequacy of cooking skills.[59,60] Molaison et al. reported the same results.[61] Additionally, African Americans in the Project EAT follow up study were less likely to be involved in food preparation and reported lower perceived adequacy of cooking skills than whites.[59]

Fast food consumption is the third meal pattern characteristic linked to adolescent fruit and vegetable consumption; a number of studies have uncovered a negative

association.[34,42,62-64] French et al. surveyed 4,746 adolescent students enrolled in Project EAT about fast food restaurant use and collected dietary information via the YAQ.[63] Males who ate fast food three or more times within the week prior to the study reported 27% less fruit consumption and 32% less vegetable consumption than males who never ate fast food in this time frame.[63] Similar results were found for females.[63] A study by Bowman et al., which incorporated a within-subject design, found that adolescents consumed fewer non-citrus fruits and non-starchy vegetables on days when fast food was consumed compared to days on which it was not.[62]

Unfortunately, the number of fast food restaurants in the United States has doubled between 1972 and 1995 and accordingly, youth's consumption of fast food has risen from 2% of total energy intake to 10% of total energy intake.[62] The average adolescent eats at a fast food establishment two times per week[63] and on any given day 30% of youth consume fast food.[62] In one study, 75% of middle and high school students reported eating fast food at least once within the week prior to the study.[63]

Across the literature, fast food consumption increases with age; high school students consume fast food more frequently than middle school students, who do so more frequently than elementary school students.[62,63,65] Greater frequency of fast food intake is also associated with male gender[62,63,66] and non-white race, specifically African American.[62,63,65] Schmidt et al. found that throughout adolescence, Black girls consumed fast food more often than white counterparts.[65] Interestingly, increased consumption of fast food has also been associated with residency in the South.[62]

Evidently, American adolescents are not coming close to meeting the DASH recommendations for fruit and vegetable consumption. Family meals and involvement in food preparation appear to be two meal pattern characteristics that are positively associated with fruit and vegetable consumption among youth. Conversely, fast food consumption has been reported as negatively related. Males, African Americans, and older adolescents may be at greatest risk for inadequate intake of fruits and vegetables as they may be less likely than females, whites, and younger adolescents to eat dinner with family and to prepare food, and at the same time more likely to eat fast food.

Dairy and Calcium

The DASH diet provided participants with three servings of low-fat dairy and 1,240 mg of calcium per day, compared to 0.5 servings of dairy and 450 mg of calcium in the control diet.[19] Because calcium is so crucial for accrual of peak bone mass during adolescence, it is recommended that adolescents consume four servings per day of milk or milk products in order to reach the adequate intake (AI) recommendation for calcium of 1,300 mg/d.[67] However, numerous studies have shown that most adolescents are not meeting these guidelines.[68-74] Recent research suggests that most adolescents are only consuming between one and two servings of milk per day[69,71,74] and between two and three servings of total dairy.[69] Average calcium intake has been reported as 700-1,217 mg/d for males and 500-1,035 mg/d for females.[68,69,73] Data from NHANES indicates that mean adolescent calcium intake falls around 66% of the AI and that only 14% of adolescents meet the guideline.[70] Furthermore, secular data show that milk consumption has declined among adolescents between the late 1970's and the mid 1990's.[75]

Virtually all studies suggest that adolescent females consume less milk, dairy, and calcium, and are less likely to meet related guidelines than adolescent males.[68-71,75-77]

Table 2. Project EAT: Average Daily Consumption by Gender[69]

	Servings of Milk	Servings of Dairy	Calcium (mg)
Males	2.0	2.9	1,217
Females	1.5	2.4	1,035

According to the 1998 Continuing Survey of Food Intakes by Individuals (CSFII), 14-18 year old males attained 89% of the AI for calcium, whereas their female counterparts only attained 54%.[76] Similarly, a telephone survey of youth ages 3-17 in Mississippi found that boys were 1.7 times more likely than girls to meet the AI for calcium.[70] Johnson et al. reported that girls 5-17 years of age were more than twice as likely than boys of the same ages to drink no milk at all.[77]

It is also generally accepted that African Americans consume less milk, dairy, and calcium, and are less likely to meet related guidelines than Caucasian adolescents.

Table 3. Project EAT: Average Daily Consumption by Race[69]

	Servings of Milk	Servings of Dairy	Calcium (mg)
Caucasians	2.1	3.1	1,231
African Americans	1.45	2.45	1,137

The 1994-96 and 1998 CSFII indicated that 95% of white adolescent males aged 14-18 years attained 95% of the AI for calcium, as compared to 74% of African American counterparts.[68] Only 58% of white and 45% of African American adolescent females met the AI. Additionally, the Mississippi telephone survey found that white youths were two times more likely than African American youths to meet the calcium AI.[70] Johnson et al.

reported that African American youth ages 5-17 years were more likely than white counterparts to drink no milk at all.[77]

Most research indicates that as youth get older they consume fewer milk and dairy products and are less likely to consume the recommended amount of calcium for their life-stage.[43,68-71,77-79] According to the 1996 CSFII, the proportion of milk drinkers less than 11 years of age was significantly higher than in the 12-17 year old age group.[71] In a prospective study of 151 girls in Pennsylvania, 90.7% of girls at age five consumed milk compared to only 78.1% of girls at age 11.[79] Significantly, this translated into a reduction from 98% of girls meeting the calcium AI at age 5 to only 27% at age 11.[79] Furthermore, the Mississippi telephone study found that with each one year increase in age, the odds of meeting the AI for calcium decreased by a factor of 0.72.[70] Other studies have found that residents of the South are less likely to consume milk, dairy, and adequate calcium.[70,77]

Adolescent dairy and calcium consumption has been linked with three meal pattern characteristics (intake of sweetened beverages, breakfast skipping, and fast food consumption) which may prove to be useful avenues for dietary intervention.

The negative association between sweetened beverages and milk consumption has been well documented.[72,80-82] Johnson et al. found that among adolescents ages 12-17, total milk consumption was significantly negatively associated with both soft drink and fruit drink consumption.[80] Dietary recalls of 13-18 year olds in the CSFII were analyzed by Harnack et al.[82] Those participants consuming 26 oz/d of soda or more were four times more likely to consume less than 8 oz/d of milk than nonconsumers of soda.[82]

Secular increases in sweetened beverage consumption have also been well documented. The prevalence of soft drink consumption among youth ages 6-17 increased from 37% in 1978 to 56% in 1998.[83] Within the same time frame, mean intake of soft drink has more than doubled from 5 oz/d to 12 oz/d and percent energy intake derived from soda has doubled from 2.9% to 5.9%.[83] Intake of other sweetened beverages (i.e. fruit drinks and sweet tea) has also increased.[75] It is estimated that 83-94% of teens regularly consume soft drinks.[82,84] The 1994 CSFII found that 32.3% of adolescents consumed less than 13 oz/d of soda, 28.1% consumed 13-25.9 oz/d, and 22.2% consumed 26 oz/d or more.[82] Although the amount of soda consumed per day appears to vary among adolescents, average daily consumption has been reported as 12-24 oz/d.[68,71,74,84]

Males, Caucasians, and older adolescents are more likely to consume sodas than females, African Americans, and younger adolescents.[68,74,78,82,83] The 1999 CSFII indicated that adolescent males were more likely than females to consume 12 oz/d or more.[82] Both data from the 1998 CSFII and 1999-2002 NHANES surveys reported that whites consume significantly more sodas than other races,[68,78,82] and that consumption increases with age.[43,74,82] However, African American adolescents consume significantly more fruit drinks/ades than other races across all age groups.[68,74,78] African American adolescent males consume 2.5 times as many of these beverages as white counterparts; African American adolescent females consume twice as many.[78] Among teens, research indicates that consumption of diet drinks, coffee, and tea is low.[78,84]

Another meal pattern characteristic negatively linked with adolescent dairy and calcium intake is breakfast skipping. It is generally accepted that adolescents who

consume breakfast have superior nutrient intakes compared to peers who skip breakfast.[85-90] The Bogalusa Heart study reported that young adults who skipped breakfast were less likely to attain 2/3 of the recommended daily allowance for many vitamins and minerals, including vitamin D and calcium.[85] Significantly higher intakes of these micronutrients were noted among breakfast eaters.[85] Two recent studies have examined the impact of ready-to-eat breakfast cereals on nutrient intake.[86,90] Adolescents who consumed ready-to-eat cereal most frequently had higher intakes of all nutrients examined, including calcium. As 95% of ready-to-eat cereal consumers do so with milk, it may be that consumption of these cereals increases dairy and calcium intake.[86]

It has been reported that 6.5-12% of children and 20-37% of adolescents skip breakfast on any given day.[44,85-87] The majority of the literature suggests that females and African Americans are the most likely subgroups to skip breakfast.[86-89] In 2005, Affenito et al. examined data from the National Heart, Lung, and Blood Institute (NHLBI) Growth and Health Study, a 9-year, longitudinal, biracial cohort study with annual 3-day food records.[89] Participants (n=2,379) were all female, ages 9-10 at baseline. White girls reported more frequent breakfast consumption than African American counterparts, a discrepancy that increased with age; whereas 18% of 18-19 year old white females reported skipping breakfast on all three days of the food record, roughly 25% of their African American counterparts reported doing so.

The third meal pattern characteristic negatively associated with dairy and calcium intake is fast food consumption.[62-64] Bowman et al. analyzed two days of 24-hour dietary recall data from 6,212 participants aged 4-19 years in the 1996 CSFII and the 1998

Supplemental Children's Survey.[62] Those participants who did not consume fast food on either day of the study consumed significantly more milk than those who consumed fast food on one or both days (302 g/d vs. 236 g/d). A within-subject analysis of a subset of 2,080 participants who ate fast food on one of the two study days was also carried out. Significantly more milk was consumed on the day when fast food was not eaten (294 g/d vs. 250 g/d).[62] In 2001, French et al. reported that of 4,710 adolescents enrolled in Project EAT, those who reported consuming fast food three or more times in the week prior to the survey consumed significantly less calcium and 20% less milk than those participants who reported never consuming fast food in the week prior to the survey.[63]

Apparently, American adolescents are falling short of both the life-stage and DASH recommendations for dairy and calcium. Sweetened beverage consumption, breakfast skipping, and fast food intake are three meal pattern characteristics that have been negatively associated with consumption of dairy and calcium among adolescents. African American and older adolescents may be at greatest risk for inadequate intake of dairy and calcium as they may be more likely than Caucasians and younger adolescents to consume sweetened beverages, skip breakfast, and to eat fast food. Both genders are at risk of inadequate dairy and calcium intake; adolescent females tend to consume fewer milk products than males and are more likely to skip breakfast, while males are more likely than females to consume soft drinks and to eat fast food.

Sodium

Although the DASH diet provided participants with roughly 3,000 mg/d of sodium, the follow up study by Sacks et al. found that even greater reductions in BP were

seen when the DASH diet was combined with sodium restriction.[19,32] The current AI for adolescent sodium intake is 1,500 mg/d and the tolerable upper intake level is 2,300 mg/d.[67] However, a number of studies have indicated that adolescents' actual intakes are well beyond these ideals, between 2,869 and 8,800 mg/d on average.[75,91-94] According to the 1999-2000 NHANES, mean daily sodium intake for 12-19 year-old males and females was 4,137 mg and 3,041 mg, respectively.[75] This is an increase from the mid 1970s when NHANES data reported average daily intake as 3,071 mg for males and 1,953 mg for females.[75] It is currently estimated that only 29% of adolescent females and 4% of adolescent males meet the recommended intake levels for sodium.[72] Few studies have addressed teen sodium intake by gender and race. Thus, although NHANES data suggests that males may consume more sodium than females, these trends are uncertain.

Increased sodium intake has been correlated with increasing age among youth.[91,65] He et. al analyzed data from 1,658 children and adolescents involved in the National Diet and Nutrition Survey for Young People in Great Britain.[91] Seven day food records were used to assess sodium intake; the average sodium consumption at age four was 4,700 mg/d while that at age 18 was 6,800 mg/d.[91] In this same study, He et al. showed that sodium intake in youth was significantly and positively associated with SBP. For each increase of 1g/d of sodium, SBP increased by 0.4 mmHg.[91] Lastly, He et al. conducted a meta-analysis of 10 studies that examined sodium restriction and BP in children and adolescents.[92] They found that as in adults, a modest reduction in salt intake (average of 42%) resulted in significant decreases in SBP (average of 1.17 mmHg).[92]

As two major sources of salt in the adolescent diet are processed foods and fast food,[75] snacking and fast food consumption are two meal pattern characteristics that may be related to sodium intake. Interestingly, the meal pattern characteristic of sweetened beverage consumption may be related to sodium intake as well.[93]

Numerous studies have reported that salty snack foods such as potato chips, pretzels, and popcorn are among the top snack food choices for adolescents[95-98] and that consumption of such items has become increasingly common in this population.[95,97,99] Zizza et al. analyzed data from nationally representative surveys from 1977 to 1996 of 8,493 young adults.[95] In this time period, the energy contribution of salty snacks doubled from 5.9% to 11.5%.[95] Stockman et al. conducted 3-day food records with 180 adolescent males and found that snacks alone provided 685 mg/d of sodium, or 46% of the AI.[100]

In general, it is estimated that 77-93.2% of adolescents consume at least one snack per day.[95-97,100-103] As many as 65.4% are consuming two or more snacks per day, with up to 28.7% snacking a minimum of four times per day.[96,101] It has been reported that the average adolescent consumes between 1.63 and 2.3 snacks per day,[95,100,102,104] contributing up to 25% of total daily energy intake.[95,96,100,102,104-106] Furthermore, snacking is becoming increasingly common. Comparison of three nationally representative surveys conducted between 1977 and 1996 revealed increases in the prevalence of adolescents who snack at least once daily, average number of daily snacking occasions, and average caloric value of each snacking occasion.[95,97,102]

Studies making demographic comparisons of adolescent snacking habits are limited. Cross et al. and Zizza et al. found no significant differences in snacking behavior

by gender.[95,96] Only two studies have addressed associations between snacking and race; one reported a greater intake of snacks among Blacks in comparison to whites,[107] and the other reported the converse.[102]

A second meal pattern characteristic that has been associated with sodium intake is fast food consumption. Paeratakul et al. examined dietary intake data of 8,307 children and adolescents who participated in the 1994/96 and 1998 CSFII.[64] They reported that participants who ate fast food on one or both survey days consumed on average 101 mg/d of sodium more than those who did not eat fast food on either day of the survey, a statistically significant difference.[64] Schmidt et al. collected dietary intake data via 3-day food records of 2,379 Black and white adolescent girls in the NHLBI Growth and Health Study and found a significant dose-dependent effect of fast food consumption on sodium intake.[65] The mean sodium intake of those who ate fast food less than once per week was 3,085 mg/d, for those who ate fast food one to three times per week was 3,134 mg/d, and for those who ate fast food four or more times per week was 3,236 mg/d.[65]

Finally, He et al. analyzed cross-sectional data from the National Diet and Nutrition Survey for young people in Great Britain and found a highly significant relationship between sodium intake and sweetened beverage consumption.[93] Multiple regression analysis revealed that for each 1 g/d increase in salt intake, consumption of soft drink increased by 27 g/d. Extrapolating this finding, the researches hypothesized that if salt intake was reduced by half among children 4-18 years of age in the U.K (average decrease of 3 g/d), the average consumption of soft drinks would decline by 81

g/d, or 2.3 soft drinks per week.[93] This is the first study to find a positive relationship between sodium and the meal pattern characteristic of sweetened beverage consumption.

It is obvious that American adolescents are exceeding age-related guidelines for sodium consumption, the tolerable upper limit for sodium, as well as the levels of sodium restriction previously shown to help decrease BP. Snacking, fast food consumption, and sweetened beverage consumption are meal pattern characteristics that have been positively associated with sodium intake and may thus be effective targets for dietary change. Males and African Americans may be at greater risk than females and whites due to greater consumption of sodium, fast foods, and maybe salty snacks.

Dietary Fat and Other Key Nutrients

The DASH diet included reductions in total fat, saturated fat, and cholesterol as compared to the control diet, which was meant to represent a typical American diet.[19] The DASH diet also provided greater levels of potassium, magnesium, and fiber.[19] However, as shown below, adolescents are not meeting DASH recommendations.

Table 4. Dietary Fat and Other Key DASH Diet Nutrients

	DASH Diet[19]	Control Diet[19]	Average[108-111] Adolescent Consumption
Total Fat (% kcal)	27	37	32.0
Saturated Fat (% kcal)	6	16	11.3
Cholesterol (mg)	150	300	250
Potassium (mg)	4,700	1,700	2,474
Magnesium (mg)	500	165	250
Fiber (g)	31	9	12.48-14.4

As with other components of the DASH diet, consumption of these nutrients has been linked to meal pattern characteristics. The positive association between dietary fat

and fast food consumption has been widely documented.[62-66,112] Snacking has also been linked with increased fat intake among adolescents.[95,97,99] Frequency of family dinner has been negatively correlated with both total and saturated fat intake[45-47,49] and positively related to intake of potassium, magnesium, and fiber.[44-47,49] Adolescent fiber intake has also been positively associated with greater involvement in food preparation[60] and negatively associated with breakfast skipping[89] and fast food consumption.[62-64,112] Finally, the literature suggests that compared to Caucasian adolescents, African American adolescents may be at greater risk for overconsumption of dietary fat and cholesterol[42,113] and at greater risk for underconsumption of micronutrients.[114]

Summary

Adolescent intake of those foods and nutrients key to the DASH diet (fruits, vegetables, low-fat dairy, calcium, sodium, total fat, saturated fat, cholesterol, potassium, magnesium, and fiber) is far from those levels shown to clinically reduce BP. Furthermore, research suggests that intake of these foods and nutrients appears to be largely dictated by meal patterns. Manipulation of meal patterns may thus be an effective strategy for facilitating dietary change among adolescents, as opposed to focusing strictly on dietary intake. An in-depth understanding of those meal patterns related to HTN risk is needed before HTN-prevention interventions aimed at youth may be carried out.

Finally, research suggests that compared to Caucasians, African American adolescents may be more likely to exhibit meal patterns that put them at higher clinical risk for HTN. This is consistent with the fact that African Americans are more likely

than Caucasians to experience early onset HTN. As such, dietary HTN intervention programs specifically targeted at this high-risk population are needed.

This project provided a better understanding of the usual meal patterns of African American adolescents and how they vary by gender and HTN risk status. This project also identified those meal patterns related to HTN risk and clinical outcome measures in this population. These findings may be used in future diet-based HTN prevention interventions for African American adolescents.

CHAPTER III

RESEARCH DESIGN AND METHODS

Data for this project was part of the database from a larger research study (NIH R21 HL077502) that: 1) examined the differences in health beliefs and lifestyle characteristics of young African Americans who varied in HTN risk and 2) compared adolescents' responses to those of their mothers. This project focused solely on describing variations in adolescent meal patterns by gender and HTN risk status.

Subject Selection

Participants were African American males and females from an urban/suburban county in the Southeastern US, ages 17-20, who participated in previous research on hemodynamics under stress, during which casual SBP, BMI, and sodium excretion under stress ($U_{NA}V$) were measured. These earlier clinical measurements were used to determine eligibility for the larger study. The selection criterion for high-risk participants was having had at least two of three HTN risk factors: BMI > 85^{th} percentile for gender and age, elevated casual SBP but not hypertensive (113 mmHg < SBP < 135 mmHg), and reduced $U_{NA}V$ ($\leq$ 0 mEq/hr) from baseline to stress. The inclusion criteria for low risk participants were having had SBP < 108 mmHg, BMI between the 15^{th} and 85^{th} percentiles for gender and age, *and* change in $U_{NA}V$ > 0 mEq/hr from baseline to stress. A more detailed description of participant selection may be found in the publication

"Views of HTN among young African Americans who vary in their risk of developing HTN" by Savoca et al., currently in press for *Ethnicity and Disease*.[11]

One hundred and twenty-four potential participants were identified from the hemodynamics research and were sent participation invitation letters. Forty-seven potential participants could not be contacted by phone or mail. Nineteen others were unavailable or not interested. Fifty-eight participants provided informed consent (as well as parental assent for minors) and received HTN education material and a $50 cash incentive upon completion.

The study protocol was approved by the Institutional Review Boards at the Medical College of Georgia in June, 2004 and University of North Carolina at Greensboro in August, 2005.

Data Collection

The primary method of data collection was in-depth, semi-structured, pilot-tested interviews. The principal investigator (PI) and a trained research assistant (RA) conducted all the interviews which lasted approximately 45-75 minutes and were audiotaped. The interview covered the following topics: beliefs about the causes and treatment of HTN; awareness of family members' HTN treatment and outcomes; eating, exercise, smoking, and sleeping habits; sources and impacts of stress; influential factors on lifestyle behaviors; views of mother's lifestyle habits.

After the interview, height and weight were measured using a digital scale with a height rod according to established protocols. BMI was calculated as weight (kg) divided by height (m^2). Blood pressure was measured thrice according to standard protocol using

a mercury sphygmomanometer. Finally, the National Cancer Institute's (NCI) Diet History Questionnaire (DHQ) was administered.[116]

Data Analysis

Medical transcriptionists transcribed all interviews verbatim. The qualitative software, Atlas.ti, v.5.1.12[117] was used to code, retrieve, and organize the rich data set. The PI and trained RAs coded all participant statements in the transcripts using a coding dictionary developed by the interviewers based upon the interview topics. All segments coded with "weekday eating" were retrieved. From these segments, a timeline was constructed for each participant to capture a visual representation of their usual meal patterns within the context of a typical 24-hour week-day. The timelines included usual foods eaten, eating times and locations, frequency of eating occasions, and the general nutritional value of foods and drinks consumed. Sleeping patterns and hours spent at work, school, or sports practices were also captured. Timelines of meal patterns, MPTs, were constructed as follows.

First, the participant's general daily activities were shaded on the MPT as sleeping (violet), school (light blue), work (peach), or sports practice (light grey). All remaining hours were left white indicating time spent at home, in transit, or other. Next, all meals (solid bars), snacks (striped bars), and drinks (spotted bars) were plotted on the timeline in half-hour increments, with the left column of a half-hour increment representing food intake; the right column representing fluid intake. Each food or drink item was plotted at one of three frequency levels: 1 = 1-2 times per week (sometimes), 2 = 3-4 times per week (usually), and 3 = 5 times per week (always). Skipped meals were

assigned the frequency level of 0 = 0 times per week (never). Finally, the quality categories (healthful, moderately healthful, or unhealthful) of foods and beverages consumed were determined by Tara Flint. Items that were nutrient-dense and low in total fat, saturated fat, sodium and sugar were classified as healthful and were colored green. Items that were nutrient-sparse, high in calories, fat, sugar, and sodium, as well as highly processed, frozen, convenience and fast foods were classified as unhealthful and were colored red. Finally, the items that did not fall into either of these two categories were classified as moderate and were colored yellow. All food and beverage classifications were reviewed and revised by the PI and other RAs.

MPTs for each participant became a new data set used to describe the differences in meal patterns between those of differing genders and HTN risk categories and to identify meal patterns related to SBP, DBP, and BMI, regardless of gender and risk categories.

Finally, participant responses to the NCI DHQ were entered into Diet*Calc Analysis Program software version 1.4.3,[118] which was used along with the DHQ Nutrient Database[119] to assess usual intake of DASH diet components (total kcal, fiber, sugar, fat, saturated fat, trans fat, cholesterol, sodium, calcium, vitamin D, magnesium, potassium, caffeine, vegetables, fruit, dairy, milk, yogurt, and cheese).

Qualitative Analysis

Aggregate data derived from participant's MPTs was used to compare the proportions of healthful, moderately healthful, unhealthful, and skipped breakfasts, lunches, and dinners across genders and risk categories. Proportions were calculated as

follows. Each participant was assigned five dinner opportunities per week, totaling 145 possible dinners for low-risk participants (29 participants * 5 week-days) and 145 possible dinners for high-risk participants (29 participants * 5 week-days). Of the 145 possible dinners for low-risk participants, the numbers of healthful, moderately healthful, unhealthful, and skipped dinners were counted and expressed as a percentage of total possible dinners. For example, if 40 dinners of low-risk participants were unhealthful, then 28% of all dinners of low-risk participants were unhealthful (40/145 * 100). The percentages of dinners eaten by high-risk participants that were healthful, moderately healthful, unhealthful, and skipped were also calculated using the same procedure. Finally, these calculated proportions were compared between low- and high-risk participants to ascertain overall differences in meal consumption patterns by risk category. Comparisons were done the same way for breakfast and lunch and for gender and subgroup analyses (i.e. males vs. females and low-risk males vs. high-risk males vs. low-risk females vs. high-risk females).

Aggregate data derived from participant's MPTs was also used to compare the average number of snacks and beverages consumed per day as well as the proportions of healthful, moderately healthful, and unhealthful snacks and beverages across risk and gender groups. Proportions were calculated as follows. For each participant, the number of snacks eaten per week was counted. Of the total number of snacks eaten by low-risk participants, the numbers of healthful, moderately healthful, and unhealthful snacks eaten were counted and expressed as a percentage of total snacks. For example, if each low-risk participant ate two snacks per day the total number of snacks was 290 (29

participants * [2 snacks per day * 5 days per week]). If 87 of these snacks were healthful, then 30% of all snacks of low-risk participants were healthful (87/290 * 100). The percentages of snacks eaten by high-risk participants that were healthful, moderately healthful, and unhealthful were also calculated using the same procedure. Finally, these calculated proportions were compared between low- and high-risk participants to determine differences in snacking behavior by risk category. Comparisons were done the same way for beverages and for gender and subgroup analyses.

As the small sample size precluded statistically significant findings, proportional differences greater than 10% were considered qualitatively important. These results were used to describe the archetypal meal patterns of the four risk-gender groups.

Quantitative Analysis

In order to systematically examine the MPTs for relevance to clinical outcome measures, a series of variables were identified from the timelines, e.g. "always eats a healthy dinner" or "snacks more than twice a day." Essentially, every possible meal pattern was attempted to be captured as a variable. Each participant was coded "1" if they definitively displayed the meal pattern variable or "0" if they did not or if it was indiscernible. Estimates of intakes of total kcal, fiber, sugar, fat, saturated fat, trans fat, cholesterol, sodium, calcium, vitamin D, magnesium, potassium, caffeine, vegetables, fruit, dairy, milk, yogurt, and cheese were obtained for each participant from the output of the Diet*Calc software. For all meal pattern variables, the average intake of each DASH diet component of participants coded with "1" was compared to that of participants coded with "0." T-tests were used to identify differences in DASH diet

components between these two groups; i.e. those who reported the meal pattern and those who did not. Results were considered significant at $p<0.05$.

Because it was postulated that an interdependence existed between some of the meal pattern variables, an exploratory principal components/factor analysis (PC/FA) was carried out to determine the underlying dimensions and to achieve data reduction. The meal pattern variables selected for the factor analysis had to meet three criteria. First, meal pattern variables had to characterize 25% to 75% of the participants to ensure adequate variance. Second, meal pattern variables had to be statistically significantly related to at least one of the DASH diet components ($p<0.05$). Third, meal pattern variables had to explain at least ten percent of the variation ($R^2 \geq 0.10$) in intake of at least one DASH component to which they were statistically significantly related. Three DASH nutrients (g fiber/1000 kcal, g sugar/1000 kcal, and mg Ca/1000 kcal) were associated with a far greater number of meal pattern variables than all other nutrients. Therefore, three additional meal pattern variables that were statistically significantly ($p<0.05$) related to these nutrients (always skips breakfast, never skips breakfast, and drinks two or more unhealthy beverages per day) were also included in the analyses, despite failing to meet the third criterion.

PC/FA with varimax rotation was used to generate factors from the meal pattern variable correlation matrix. The following four criteria were used to arrive at the final number of factors retained: eigenvalues greater than or equal to 1.0, variable loadings (≥ 0.5) on one and only one factor (i.e. simple solution), communalities $\geq 50\%$, and variance distribution across all factors.

Standardized factor scores were generated for each participant from the final factor solution. These were used in subsequent step-wise regression models with factors as the independent variables and SBP, DBP, and BMI as the dependent variables. Based on the results of the stepwise models, reduced models containing only factors related to SBP, DBP, and BMI, respectively, were used for analysis. These models were also used to assess the variance (R^2) in SBP, DBP, and BMI uniquely explained by the meal pattern factors.

All statistical analyses were performed using JMP software (version 6.0.3, 2006, SAS Institute, Cary, NC).[120]

CHAPTER IV

RESULTS

Participants

Fifty-eight participants completed the study. Twenty-nine participants were high-risk African American adolescents (14 females) and 29 participants were low-risk African American adolescents (16 females). There were no differences in age between the groups (mean = 18.6 years). Regardless of gender, high-risk participants had higher SBP (118.12 vs. 108.23, $p<0.001$), DBP (72.88 vs. 67.45, $p<0.01$), and BMI (33.03 vs. 21.97, $p<0.0001$), measured at the time of the interview. A summary of participant characteristics is given in Table 5.

Table 5. Participant Characteristics (mean ± SD)

Characteristic	HRM (n=15)	LRM (n=13)	HRF (n=14)	LRF (n=16)	High-Risk (n=29)	Low-Risk (n=29)	All (n=58)
Age (years)	18.56 ± 1.06	18.4 ± 1.29	19.8 ± 1.9	18.21 ± 0.95	18.92 ± 1.21	18.30 ± 1.10	18.6 ± 1.19
BMI (kg/m^2)	31.91 ± 5.7	22.28 ± 2.77	34.58 ± 7.64	21.72 ± 2.64	33.03 ± 6.63	21.97 ± 2.67	27.4 ± 7.48
Systolic Blood Pressure (mmHg)	120.66 ± 11.67	108.4 ± 7.98	116.92 ± 10.16	108.08 ± 10.14	118.12 ± 10.81	108.23 ± 9.08	113.09 ± 11.07
Diastolic Blood Pressure (mmHg)	74.73 ± 6.62	67.77 ± 6.69	71.69 ± 9.24	67.19 ± 5.19	72.88 ± 7.98	67.45 ± 5.61	70.12 ± 7.35

HRM = high-risk males; LRM = low-risk males; HRF = high-risk females; LRF = low-risk females

Aim 1: Meal Pattern Timelines

The MPTs began with sleep, captured daily events after awakening (i.e. school, work, sports), and ended with sleep. Generally, about half of all participants were in

high school and a third were in college. The remaining 15% were not currently enrolled in school. The only risk-gender group in which the majority of participants were not in high school was the high-risk females. For this group, college and not in school were equally the most predominate. While the majority of low-risk males and high-risk females were currently working (53.9% and 57.1%, respectively), fewer low-risk females (43.8%) and only three high-risk males (20.0%) worked. High-risk males were more likely than any other risk-gender group to be on a sports team. Participants averaged about seven hours of sleep per night, waking up around 7:15 a.m. and going to bed around 12:00 a.m., with no significant differences by risk-gender group. These MPT characteristics are detailed below in Table 6.

Table 6. Meal Pattern Timeline Characteristics

Characteristic	**HRM (n=15)**	**LRM (n=13)**	**HRF (n=14)**	**LRF (n=16)**	**High-Risk (n=29)**	**Low-Risk (n=29)**	**All (n=58)**
Status (# Participants)							
High School	10 (66.7%)	8 (61.5%)	4 (28.6%)	9 (56.3%)	14 (48.3%)	17 (58.6%)	31 (53.4%)
College	4 (26.7%)	3 (23.1%)	5 (35.7%)	6 (37.5%)	9 (31%)	9 (31%)	18 (31.0%)
Not in School	1 (6.7%)	2 (15.4%)	5 (35.7%)	1 (6.3%)	6 (20.1%)	3 (10.3%)	9 (15.5%)
Working (# Participants)	3 (20.0%)	7 (53.9%)	8 (57.1%)	7 (43.8%)	11 (37.9%)	14 (48.3%)	25 (43.1%)
Sports Team (# Participants)	3 (20.0%)	1 (7.7%)	0 (0.0%)	1 (6.3%)	3 (10.3%)	2 (6.9%)	5 (8.6%)
Wake Time (hour:min)	7:25	7:14	7:04	7:11	7:14	7:12	7:13
Bed Time (hour:min)	12:16	12:23	11:36	12:17	11:56	12:19	12:08
Hours of Sleep (hours ± SD)	7.13 ± 1.11	6.85 ± 1.28	7.46 ± 1.22	6.91 ± 1.28	7.29 ± 1.15	6.88 ± 1.26	7.09 ± 1.21

HRM = high-risk males; LRM = low-risk males; HRF = high-risk females; LRF = low-risk females

Participants ate a common set of foods and drinks that were classified as healthful, moderately healthful, or unhealthful (Table 7). Broadly, foods that were nutrient-dense and low in total fat, saturated fat, sodium, and sugar were classified as healthful. Foods that fell into this category and that were commonly eaten by participants included fruit, vegetables, yogurt, whole-grain breads, pasta, cereal, and baked or grilled chicken and fish. On the other hand, foods that were high in calories, fat, sugar, and sodium, as well as highly processed, frozen, convenience and fast foods were classified as unhealthful. Commonly eaten foods from this category included pizza, hamburgers, French fries, sausage biscuits, bacon, doughnuts, hot dogs, fried meats, Ramen noodles, cookies, candy, and ice cream. The foods that could neither be distinctly classified as healthful nor as unhealthful were classified as moderately healthful. Examples of moderately healthful foods included peanut butter and jelly sandwiches, macaroni and cheese, cereal bars, eggs, grits, baked and grilled red meats, supplement shakes, and popsicles. Water and milk were considered healthful drinks while regular sodas, sweet tea, and fruit drinks such as Kool-Aid and Hi-C were classified as unhealthful. Diet sodas, flavored milks, and 100% fruit juice were classified as moderately healthful.

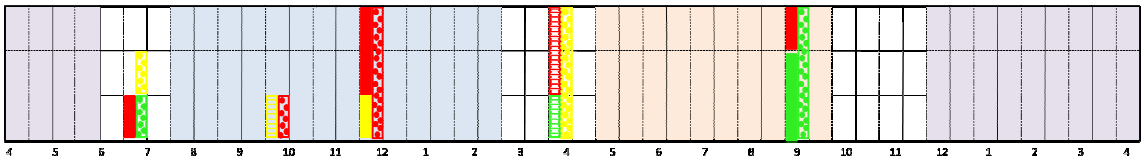
Table 7. Examples of Commonly Consumed Foods & Drinks by Quality Category			
	Healthful	**Moderate**	**Unhealthful**
Breakfast	Fruit Cereal Yogurt	Cereal bar Eggs Grits	Sausage biscuit Doughnuts Toaster pastry
Lunch	Salad Deli sandwich Fruit	Grilled cheese Peanut butter & jelly sandwich	Pizza Fast food Corn dogs/hot dogs
Dinner	Chicken/fish Vegetables Pasta	Grilled cheese Ham/red meat Mac & cheese	Fast food Fried chicken Frozen foods
Snacks	Fruit Cereal Popcorn	Cereal bar Supplement shake Popsicle	Cookies Candy/candy bars Chips
Drinks	Water Milk	100% fruit juice Diet sodas Flavored milk	Regular sodas Fruit drinks Sweet tea

The MPTs of participants belonging to the same risk-gender groups displayed some similar patterns, allowing characterization of a typical MPT for each group. A typical week-day schedule for a low-risk male would be as follows:

6:00 a.m. – Wake up
6:30 a.m. – Usually skips breakfast. Sometimes picks up a sausage biscuit from McDonald's on the way to school. Usually has a drink which may be either water or orange juice.
7:30 a.m. – High school starts
9:30 a.m. – Sometimes eats a cereal bar as a snack. Sometimes has a coke.
11:30 a.m. – Usually eats school lunch (pizza & fries). Sometimes brings a peanut butter & jelly sandwich from home. Always has sweet tea to drink.
2:30 p.m. – High school ends
3:30 p.m. – Always has a snack after school, which is usually Ramen Noodles. Sometimes the snack is a banana. He always drinks chocolate milk regardless of the snack.
4:30 p.m. – Goes to work at Wendys.
8:30 p.m. – Usually eats a grilled chicken salad for dinner during his break. Sometimes has a cheeseburger. He always drinks water with dinner.
9:30 p.m. – Comes home from work.
11:30 p.m. – Goes to bed

The corresponding typical MPT of a low-risk male is shown below in Figure 1.

Figure 1. Typical MPT of Low-Risk Male

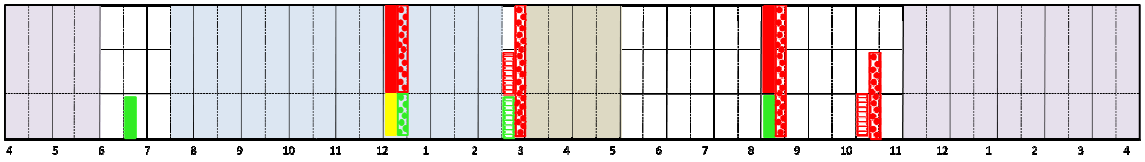


A typical week-day schedule for a high-risk male would be as follows:

6:00 a.m. – Wake up
6:30 a.m. – Usually skips breakfast. Sometimes grabs a banana on the way out the door to school.
7:30 a.m. – High school starts
12:00 p.m. – Always eats school lunch (cheeseburger & fries). Sometimes eats a grilled cheese sandwich. Usually drinks coke. Sometimes drinks 2% milk.
2:30 p.m. – High school ends. Usually eats a snack before sports practice (either chips or an apple). Always drinks a Powerade.
3:00 p.m. – Sports practice starts
5:00 p.m. – Sports practice ends. He goes home.
8:30 p.m. – Eats what his mom makes for dinner. Usually fried chicken and a frozen side such as French fries. Sometimes she makes spaghetti. Always drinks Kool-Aid.
10:00 p.m. – Usually drinks more Kool-Aid before going to bed. Sometimes snacks on ice cream.
11:00 p.m. – Goes to bed

The corresponding typical MPT of a high-risk male is shown below in Figure 2.

Figure 2. Typical MPT of High-Risk Male



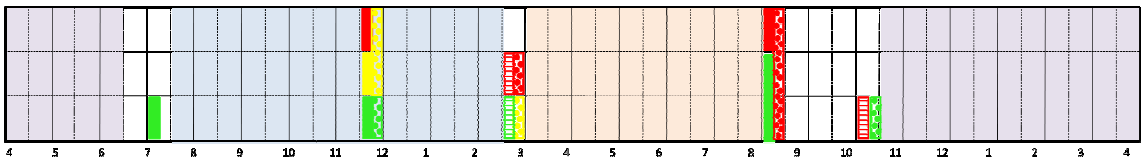
A typical week-day schedule for a low-risk female would be as follows:

6:30 a.m. – Wake up
7:00 a.m. – Usually skips breakfast. Sometimes eats a yogurt.
7:30 a.m. – High school starts
11:30 p.m. – Usually eats a turkey or ham and cheese sandwich from home with an apple or baked potato chips. Sometimes buys school lunch when they serve Steak & Cheese subs. Usually drinks chocolate milk. Sometimes just has water.
2:30 p.m. – High school ends. Usually eats a snack before work (either a candy bar or popcorn). Drinks either a coke or orange juice with her snack.
3:00 p.m. – Starts working at McDonald's.
8:00 p.m. – Gets off of work and goes home. Usually eats a home-made dinner with vegetables. Sometimes will bring home a big mac with her from work. Always drinks sweet tea.
10:00 p.m. – Sometimes snacks on cookies with milk.

10:30 p.m. – Goes to bed.

The corresponding typical MPT of a low-risk female is shown below in Figure 3.

Figure 3. Typical MPT of Low-Risk Female

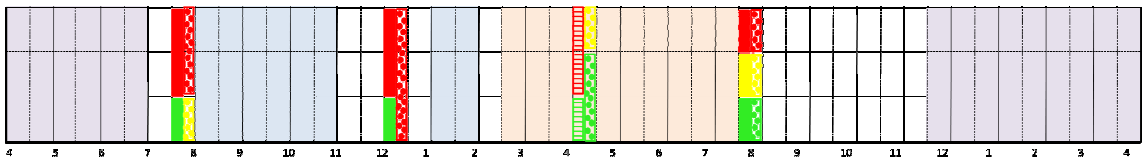


A typical week-day schedule for a high-risk female would be as follows:

7:00 a.m. – Wake up
7:30 a.m. – Always eats breakfast at the school cafeteria. Usually has waffles or pancakes. Sometimes will grab a bowl of cereal. Usually drinks Sunny D. Sometimes drinks cranberry juice.
8:00 a.m. – First class of the day starts.
11:00 a.m. – Second class of the day ends
12:00 p.m. – Eats lunch with friends at the school cafeteria. Usually has a chicken biscuit from Chik-Fil-A with waffle fries. Sometimes has sushi. Always drinks sweet tea.
1:00 p.m. – Third class of the day starts.
2:00 p.m. – Third class of the day ends.
2:30 p.m. – Goes to work at the mall.
4:00 p.m. – Always eats a snack. Usually has a big chocolate chip cookie with water. Sometimes has an apple and diet Pepsi.
7:30 p.m. – Works ends. Usually eats dinner either in her dorm room (a frozen entrée or macaroni and cheese). Sometimes she eats baked chicken with pasta from the school cafeteria. Depending on her mood she drinks milk, water, diet coke, orange juice, or Kool-Aid.
11:30 p.m. – Goes to bed.

The corresponding typical MPT of a high-risk female is shown below in Figure 4.

Figure 4. Typical MPT of High-Risk Female



In conclusion, the MPT provided a convenient way to visually depict participants' usual meal patterns. It also easily captured those elements of a typical week-day likely to

influence eating behaviors. The process of constructing MPTs for all participants enabled the identification and quality classification of foods and beverages typically consumed by African American adolescents. Furthermore, examining the timelines by risk-gender groups enabled the characterization of archetypal MPTs for each group. The MPTs for all participants by gender-risk category can be found in Appendix A.

Aim 2: Qualitative Analysis

The comparison of MPTs across groups provided a view of distinct meal patterns differentiating participants based upon gender and HTN risk. Differences in meals, snacks, and beverages were more apparent between HTN risk groups than between males and females. However, males ate fewer healthful lunches and skipped breakfast more often than females. Participants ate healthful meals about one-third of the time. Although high-risk participants ate unhealthful meals more often than low-risk participants, low-risk participants consumed moderately healthful meals or skipped meals more frequently. Finally, high-risk participants consumed unhealthful beverages and snacks more frequently than low-risk participants. These findings as well as additional sub-group analyses are further discussed below, by meal type.

Breakfast

Participants of all risk-gender groups skipped breakfast roughly half the time, except for high-risk females. This group only skipped breakfast a quarter of the time and consumed unhealthful breakfasts, such as sausage biscuits, doughnuts, and toaster pastries, more frequently than all other groups. Forty-six percent of HRF breakfasts were unhealthful compared to 8% of LRF, 18% of HRM, and 31% of LRM. Accordingly, a

greater percentage of low-risk participants' breakfasts were skipped compared to high-risk participants' breakfasts, which were more often unhealthy. Males skipped breakfast more frequently than females. Interestingly, more HRM breakfasts were healthful, incorporating fruit, cereal, or yogurt, than LRM breakfasts (27% vs. 13%). These data are captured in Figure 5.

Lunch

Although females ate healthful lunches more often than males, more than 50% of all participants' lunches were unhealthful. Most lunches were eaten at high school cafeterias and consisted of pizza, hamburgers, or corn dogs with French fries. Both low- and high-risk participants ate healthful lunches such as salads or deli sandwiches less than 15% of the time. However, low-risk participants were more likely than high-risk participants to eat moderately healthful lunches like peanut butter and jelly or grilled cheese sandwiches. Low-risk females ate unhealthy lunches the least often of all risk-gender groups; 52% of LRF lunches were unhealthful compared to 69% of HRF, 64% of LRM, and 69% of HRM. Finally, skipping lunch was very uncommon. These data are captured in Figure 6.

Figure 5. Percentage of Healthful, Moderate, Unhealthful, and Skipped Breakfasts

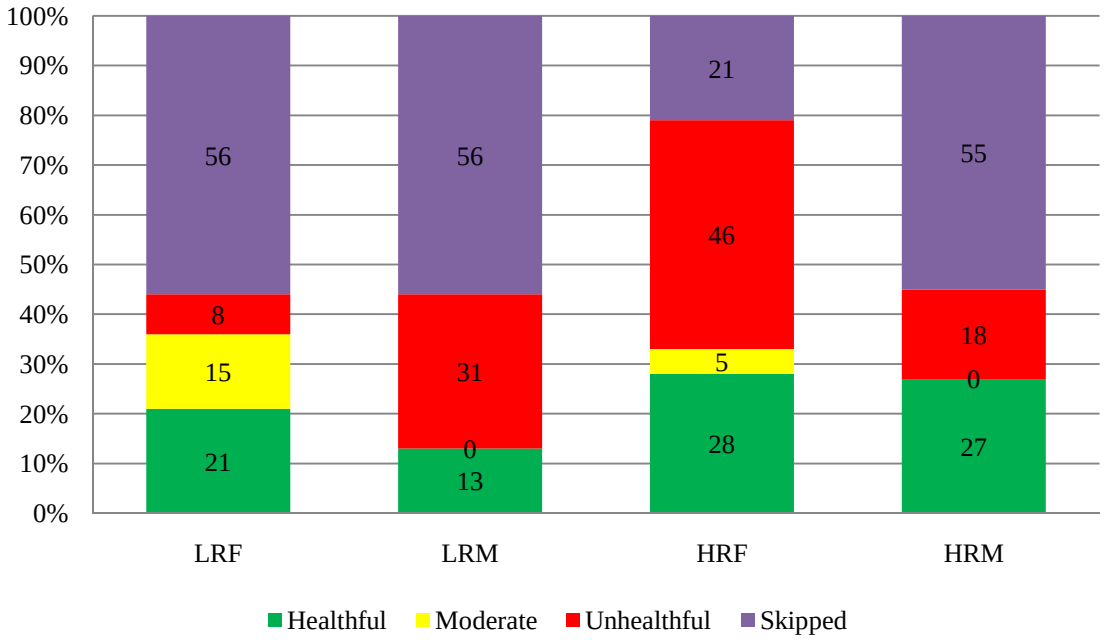
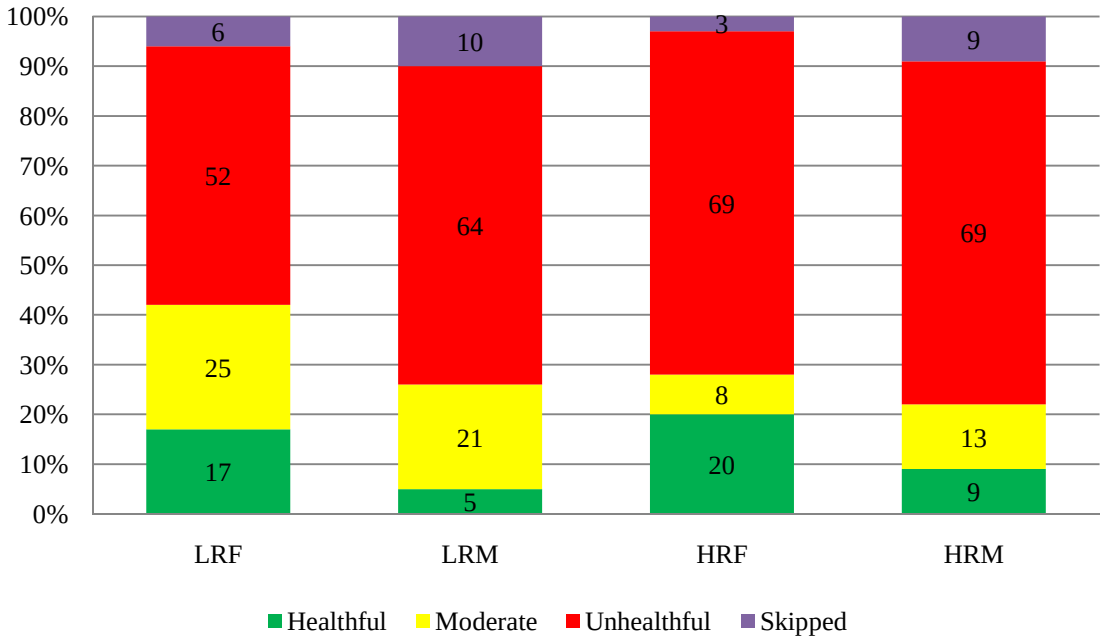


Figure 6. Percentage of Healthful, Moderate, Unhealthful, and Skipped Lunches



Dinner

A greater proportion of low-risk participants' dinners were healthful (59%) compared to high-risk participants' dinners (46%). Healthful dinners were most often home-cooked, eaten in the home with family, and included vegetables. Examples include baked or grilled chicken or fish with corn, green beans, and salad. Pasta was another commonly eaten healthful meal. On the other hand, most unhealthful meals were either eaten away from the home at fast food restaurants or consisted of convenience foods such as Buffalo wings, Ramen noodles, or frozen French fries. Whereas males reported eating either healthful or unhealthful dinners, 17% of all females reported eating at least one moderately healthful dinner per week (i.e. grilled or baked red meat, grilled cheese, or macaroni and cheese). Low-risk males ate healthy dinner more often than all other risk-gender groups; 64% of LRM dinners were healthful compared to 49% of HRM, 54% of LRF, and 44% of HRF. Participants skipped dinner very infrequently. These data are captured in Figure 7.

Snacks

Most participants ate at least one snack per day. More low-risk participants (31%) than high-risk participants (21%) snacked at least twice per day. Although most snacks eaten were unhealthful, compared to high-risk participants more low-risk participants' snacks were healthful (15% vs. 36%) and a fewer were unhealthful (77% vs. 64%). Common healthful snacks included fruit, cereal and popcorn, while popular unhealthful snacks were cookies, candy, candy bars, and chips. Low-risk females ate more healthful snacks than all other risk-gender groups; 40% of LRF snacks were

healthful, compared to 19% of HRF, 29% of LRM, and 24% of HRM. These data are captured in Figure 8.

Figure 7. Percentage of Healthful, Moderate, Unhealthful, and Skipped Dinners

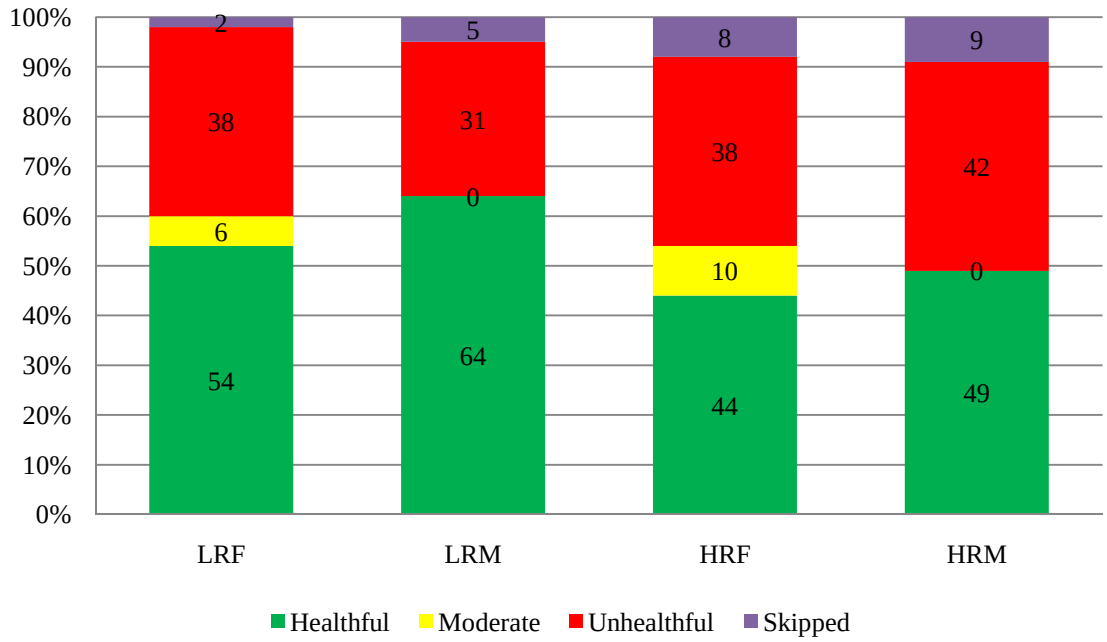
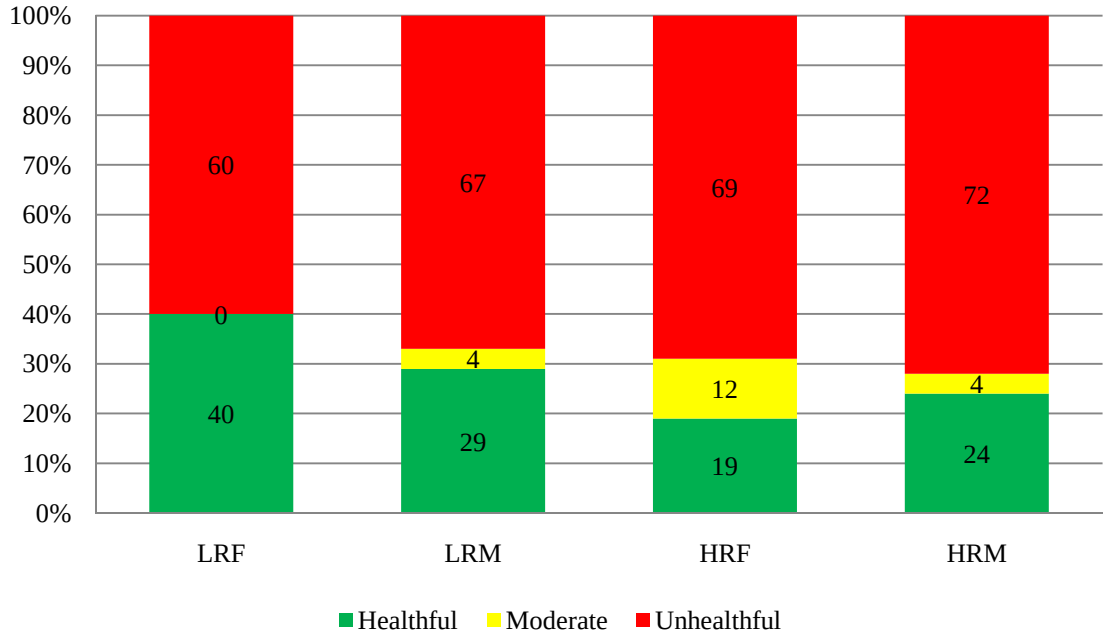


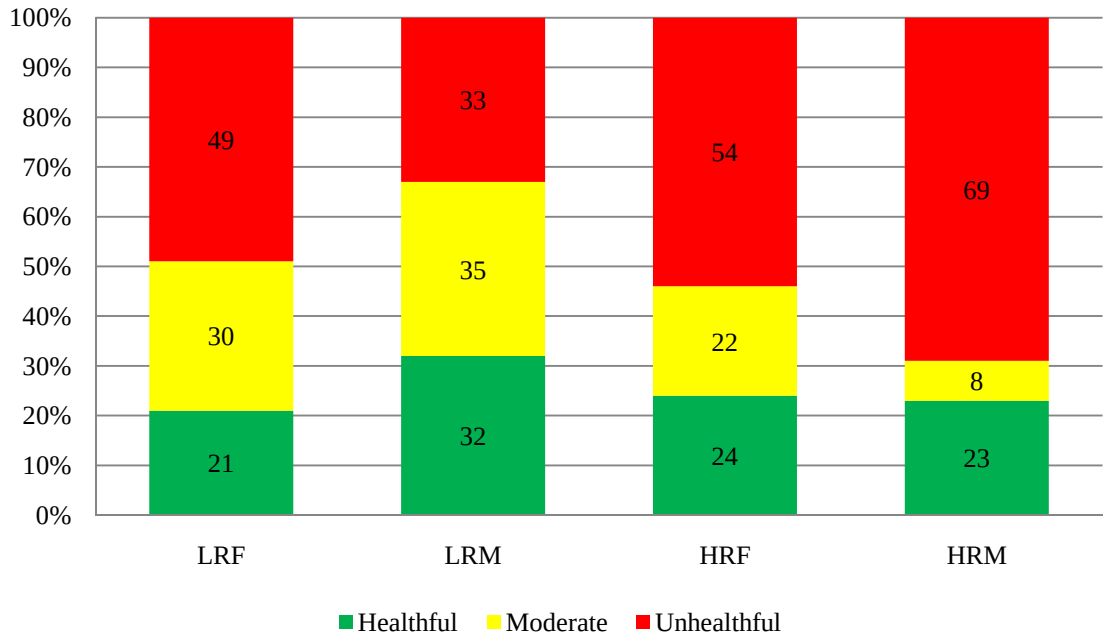
Figure 8. Percentage of Healthful, Moderate, and Unhealthful Snacks



Beverages

Both high- and low-risk participants drank on average about three beverages per day. Compared to high-risk participants' beverages, fewer low-risk participants' beverages were unhealthful (64% vs. 41%) and more were moderately healthful (13% vs. 33%). The most commonly consumed unhealthful beverages were soda, fruit drinks (i.e. Kool-Aid, Sunny-D, Mystic), and sweet tea. Moderately healthful beverages consumed included 100% fruit juice, flavored milk, and diet soda. Healthy beverages (i.e. milk or water) were only drunk a quarter of the time by all participants. Low-risk males drank soda, fruit drinks, and sweet tea the least often of all risk-gender groups and also drank milk and water the most often. These data are captured in Figure 9.

Figure 9. Percentage of Healthful, Moderate, and Unhealthful Beverages



Overall, low-risk participants appeared to have healthier meal patterns than high-risk participants. Compared to high-risk participants, low-risk participants consumed fewer unhealthful dinners, snacks, and beverages. Low-risk males stood out by consuming more healthful dinners and fewer unhealthful beverages than all other risk-gender groups. Low-risk females ate unhealthy lunches the least frequently of all risk-gender groups and were the most likely to consume healthful snacks. On the other hand, high-risk males drank the most soda, fruit drinks, and sweet tea and high-risk females were most likely to eat an unhealthful breakfast. The MPT was a useful qualitative analysis tool that facilitated the identification and description of distinctive meal patterns of participants of differing genders and HTN risk categories.

Aim 3: Quantitative Analysis

In order to determine which meal patterns were related to positive clinical outcomes, the associations between meal pattern variables identified from participants' MPTs and intake of DASH diet components derived from the DHQ were examined. Select meal pattern variables were grouped into factors for which each participant received an individual factor score. The factor scores were used as dependent variables in step-wise analyses with SBP, DBP, and BMI, measured at the time of the interview, as independent variables.

Selection of Meal Pattern Variables

Fifty-four meal pattern variables were identified from participants' MPTs, e.g. "always skips breakfast" or "never eats a healthy dinner." Thirty-six meal pattern variables failed to meet three criteria for inclusion and did not go on to further analysis.

Nine meal pattern variables did not have statistically significant relationships with any of the DASH nutrients. Twenty-three meal pattern variables were displayed by less than 25% of participants and three meal pattern variables were displayed by greater than 75% of participants. Finally, four meal pattern variables did not explain at least 10% of the variance (R^2 >= 0.10) of statistically related DASH nutrients. However, as explained in the methods, three of these four variables were retained as they were statistically significantly associated with one of three DASH diet components that were associated with a far greater number of meal pattern variables than all other nutrients. The 36 meal pattern variables that did not meet the inclusion criteria for the multivariate analyses are listed in Table 8. The 20 meal patterns that were used in multivariate analyses and their relationships with DASH diet components are given in Table 9.

Table 8. Meal Pattern Variables Excluded from Multivariate Analyses	
Failed to Characterize 25% - 75% of Participants	
Always eats unhealthy dinner	Always drinks unhealthy beverages
Never eats healthy dinner	Drinks one or fewer healthy beverages/day
Eats 3-5 healthy lunches/week	Drinks two or more healthy beverages/day
Always eats healthy lunch	Drinks three or more healthy beverages/day
Never eats healthy lunch	Always drinks healthy beverages
Eats more healthy lunches than unhealthy lunches	Snacks ever
Eats 3-5 unhealthy breakfasts/week	Snacks three or more times/day
Always eats unhealthy breakfast	Always eats healthy snacks
Always eats healthy breakfast	Eats more healthy than unhealthy snacks
Eats more healthy than unhealthy breakfasts	Eats two or more healthy snacks/day
Drinks five or more beverages per day	Eats two or more unhealthy snacks/day
Never drinks unhealthy beverages	
Not Statistically Significantly Related to Any DASH Diet Component	
Eats at least as many healthy breakfasts as unhealthy	Drinks as many healthy beverages as unhealthy
Never eats unhealthy breakfast	Never eats unhealthy snacks
Drinks more healthy than unhealthy beverages	Always eats unhealthy snacks
Drinks < 3 beverages/day	Eats at least as many healthy snacks as unhealthy
Never drinks healthy beverages	
Accounted for < 10% of the Variation in Statistically Related DASH Diet Components	
Drinks 4 or more beverages/day	Always skips breakfast[∓]
Never skips breakfast[∓]	Drinks 2 or more unhealthy beverages/day[∓]
[∓]**Meal pattern variable retained for multivariate analyses**	

Table 9. Relationship Between DASH Diet Components and Meal Pattern Variables Included in Multivariate Analyses																													
Characteristic	**N**	**total kcal**	**g fiber**	**g fiber/1000**	**g sugar/1000**	**g total fat**	**g fat/1000**	**g sat fat**	**g sat fat/1000**	**g trans fat**	**mg chol**	**mg chol/1000**	**mg Na**	**mg Na/1000**	**mg Ca**	**mg Ca/1000**	**µg vitamin D**	**mg Mg**	**mg K**	**mg caffeine**	**svgs veg**	**svgs fruit**	**svgs fr & veg**	**svgs dairy**	**svgs milk**	**svgs yogurt**	**svgs cheese**
Always eats healthy dinner	15			X												X	X							X	X		
Never eats unhealthy dinner	20															X	X							X	X		
Eats more healthy dinners than unhealthy dinners	31			X												X											
Eats 3-5 healthy dinners/week	31			X												X											X
Eats 3-5 unhealthy dinners/week	21			X										X		X											
Eats at least as many healthy dinners as unhealthy dinners	37			X										X		X											
Always eats unhealthy lunch	27					X				X																	
Eats 3-5 unhealthy lunches/week	38			X																							
Eats at least as many healthy lunches as unhealthy lunches	18	X		X																							
Never eats unhealthy lunch	15			X																							
Always skips breakfast†	24																										
Never skips breakfast†	25																										
Never eats healthy breakfast	41			X																							
Drinks ≥2 unhealthy beverages/day†	27																										
Drinks ≥3 unhealthy beverages/day	15																					X					
Snacks ≥2 times/day	15		X												X		X	X	X				X		X		
Eats ≥1 healthy snack/day	16				X																						
Snacks ≥1 time/day	43				X																						
Never eats unhealthy snacks	19				X																						
Eats ≥1 unhealthy snack/day	36				X																						
Shaded boxes indicate statistically significant relationships. 'X' indicates R^2 >0.10. † indicates a criteria exception meal pattern variable.																											

Exploratory Factor Analysis

Principal component analysis with Varimax rotation was used to generate factors from the correlation matrix of the selected 20 meal pattern variables. Four criteria were used to arrive at the final number of factors and to achieve a simple structure solution. First, all factors had eigenvalues ≥ 1.0 (range was 1.21 to 5.35). Second, each meal pattern variable possessed a single high loading (≥0.50) on only one factor (range was 0.65 to 0.95). Third, communalities were ≥ 0.50 for all meal pattern variables (range was 0.62 to 0.92). Finally, the solution explained a substantial portion of the variance (81.23%), which was distributed across all factors (7.8%-21.9%).

The six factors identified were *Healthy Dinner, Healthy Lunch, Unhealthy Snacks, Skipped Breakfast, Unhealthy Beverages,* and *Healthy Snacks*. *Healthy Dinner* and *Healthy Lunch* represented frequent consumption of healthful dinner and lunch foods, respectively, and infrequent consumption of unhealthful dinner and lunch foods, respectively. *Skipped Breakfast* represented frequent skipping of breakfast. *Unhealthy Snacks* characterized consumption of at least one unhealthy snack per day, such as cookies, chips, or candy. Conversely, *Healthy Snacks* indicated more frequent consumption of snacks and inclusion of healthful items such as fruit, cereal, or popcorn. *Unhealthy Beverages* represented frequent consumption of sodas, fruit drinks, sweet tea, and sports drinks. The factor solution is detailed in Table 10.

Table 10. Factor Rotation From Meal Pattern Variables Derived From Participants' MPTs (n=58): Factor Loadings and Percent of Variance Explained

	Factors						Communalities
	1	2	3	4	5	6	
Factor 1: Healthy Dinner							
Always eats healthy dinner	**-0.89**	-0.16	-0.20	0.14	0.08	0.11	0.89
Never eats unhealthy dinner	**0.89**	0.06	0.08	-0.22	-0.07	0.00	0.86
Eats more healthy dinners than unhealthy diners	**0.7**	0.09	0.00	0.11	0.00	0.43	0.69
Eats 3-5 healthy dinners/week	**0.72**	-0.01	-0.09	0.14	0.07	0.44	0.75
Eats 3-5 unhealthy dinners/week	**0.89**	0.05	-.08	-0.22	-0.07	0.00	0.86
Eats at least as many healthy dinners as unhealthy dinners	**0.89**	0.16	0.02	-0.14	-0.08	-0.11	0.89
Factor 2: Healthy Lunch							
Always eats unhealthy lunch	-0.10	**-0.94**	0.01	0.06	0.10	-0.02	0.91
Eats 3-5 unhealthy lunches/week	-0.03	**-0.78**	-0.01	0.01	-0.04	0.00	0.62
Eats as least as many healthy lunches as unhealthy lunches	0.11	**0.90**	-0.08	-0.01	0.11	0.00	0.82
Never eats unhealthy lunch	0.11	**0.94**	0.03	-0.06	-0.09	-0.06	0.92
Factor 3: Unhealthy Snacks							
Eats at least one snack per day	0.12	-0.09	**0.85**	0.08	-0.06	0.23	0.82
Eats at least one unhealthy snack per day	0.18	0.04	**0.93**	0.11	0.04	0.02	0.91
Never eats unhealthy snacks	-0.05	0.03	**-0.95**	-0.12	0.04	-0.07	0.92
Factor 4: Skipped Breakfast							
Always skips breakfast	-0.12	0.06	0.12	**0.84**	0.16	0.01	0.77
Never skips breakfast	0.11	0.01	-0.01	**-0.91**	-0.01	-0.08	0.85
Never eats a healthful breakfast	-0.18	-0.23	0.21	**0.78**	-0.14	-0.15	0.78
Factor 5: Unhealthy Beverages							
Drinks at least two unhealthy beverages per day	-0.16	0.00	-0.11	0.06	**0.89**	-0.08	0.84
Drinks three or more unhealthy beverages per day	-0.01	-0.10	0.06	0.11	**0.87**	-0.13	0.80
Factor 6: Healthy Snacks							
Eats at least two snacks per day	0.12	0.06	0.44	0.00	0.00	**0.65**	0.64
Eats at least one healthy snack per day	-0.02	-0.09	0.10	-0.06	-0.24	**0.79**	0.70
Percent Variance Explained	21.90	16.75	14.38	11.87	8.53	7.8	81.23

Loadings ≥ 0.50 are in bold. Loadings are interpreted as the correlation between each variable and the factor. Higher absolute value of loadings indicate that the variable shares more variance with that factor. The sign of the loading determines the direction of the relationship of each variable to the factor.

Relationships of Meal Pattern Factors with Clinical Parameters

Standardized factor scores were generated for each participant from the final factor solution and used as dependent variables in three separate step-wise analyses with the clinical parameters SBP, DBP, and BMI, measured at the time of the interview, as independent variables. Factors that had significant relationships with the clinical parameters in the full models were retained in the final reduced models.

A step-wise model containing all six factors indicated significant relationships between four of the factors (*Healthy Lunch, Unhealthy Snacks, Skipped Breakfast,* and *Unhealthy Beverages*) and SBP. These four factors were retained in a final reduced model that statistically significantly predicted SBP ($p=0.03$, $R^2=0.18$) (Table 11). Higher factor scores for *Healthy Lunch* and *Skipped Breakfast* were related to lower SBP. Lower factor scores for *Unhealthy Snacks* and *Unhealthy Beverages* were related to lower SBP. *Unhealthy Snacks* ($p=0.04$, $pR^2=0.07$) and *Healthy Lunches* ($p=0.06$, $pR^2=0.06$) had the strongest relationship with SBP and accounted for the largest portion of the total variance. *Unhealthy Beverages* ($p=0.08$, $pR^2=0.05$) and *Skipped Breakfast* ($p=0.17$, $pR^2=0.03$) had the weakest relationships with SBP and accounted for the least amount of total variance. In general, as the consumption of unhealthful snacks and beverages decreased, and the frequency of skipping breakfast and eating healthful lunches increased, SBP decreased.

Step-wise models containing all factors identified two factors related to DBP (*Unhealthy Snacks* and *Unhealthy Beverages*) and two factors related to BMI (*Healthy Dinner* and *Skipped Breakfast*). These factors were then used in two distinct final

reduced models, one which predicted DBP with marginal significance (p=0.07, R^2=0.09) and one which statistically significantly predicted BMI (p=0.05, R^2=0.10) (Table 11). Lower factor scores for *Unhealthy Beverages* (p=0.05, pR^2=0.07) and *Unhealthy Snacks* (p=0.13, pR^2=0.04) were related to lower DBP. Higher factor scores for *Skipped Breakfast* (p=0.02, pR^2=0.09) and *Healthy Dinner* (p=0.04, pR^2=0.07) were related to lower BMI. Generally, as the consumption of unhealthful beverages and snack foods decreased, DBP decreased and as the frequency of eating healthful dinners and skipping breakfast increased, BMI decreased.

Table 11. Prediction of Clinical Parameters by Reduced Models

Clinical Parameters	Reduced Model (R^2)	Healthy Dinner (pR^2)	Healthy Lunch (pR^2)	Unhealthy Snacks (pR^2)	Skipped Breakfast (pR^2)	Unhealthy Beverages (pR^2)	Healthy Snacks (pR^2)
SBP	0.03* (0.18)		0.06† (0.06)	0.04* (0.07)	0.17 (0.03)	0.08† (0.05)	
DBP	0.07† (0.09)			0.13 (0.04)		0.05* (0.07)	
BMI	0.05* (0.10)	0.04* (0.07)			0.02* (0.09)		

†p-value <0.10
*p-value < 0.05
SBP (Systolic Blood Pressure); DBP (Diastolic Blood Pressure); BMI (Body Mass Index)

CHAPTER V

CONCLUSIONS

Discussion

This research adds to the very sparse literature on diet and HTN among adolescents and is unique in that a novel approach to assessing diet for the purposes of dietary counseling and change was developed. This approach, the Meal Pattern Timeline (MPT), is a new tool that captures a visual representation of an individual's usual meal patterns within the context of a typical week-day. In this study, MPTs were easily constructed from participants' descriptions of usual week-day eating habits from transcribed in-depth interviews. The MPTs were used to identify common foods eaten by African American adolescents, to compare gross meal patterns between participants of differing genders and HTN risk, and to identify meal pattern variables which were related to intake of components of the DASH diet. These meal pattern variables were ultimately grouped into six factors, which predicted SBP, DBP, and BMI in step-wise analyses. The results of this research suggest that the MPT is a practical and versatile tool for both qualitative and quantitative research in nutrition and disease prevention.

Nutrition screening or assessment is a prerequisite for establishing the most appropriate type of nutrition intervention for adolescents.[121] The four most commonly used dietary assessment methods (24-hour recall, FFQ, food record, DHQ) all have considerable known weaknesses (Table 12).[5,121] The novel dietary assessment tool

developed in this research, the MPT, combines the methodology of the 24-hr recall and the FFQ, blending their strengths and minimizing their limitations. Like a 24-hour recall, the MPT does not require respondent literacy and follows a step-by-step progression through the day, which facilitates recall of food by framing the context of eating or drinking events. However, the MPT does not rely on respondent memory or risk capturing an atypical day. At the same time, the MPT is representative of usual intake as is a FFQ, but does not restrict a person to a preselected list of foods and is not particularly time-consuming. Furthermore, the MPT does not demand a large respondent burden as do food records, nor does it require expensive and labor intensive data entry as does the DHQ. Finally, although the MPT is not intended for nutrient analysis, it captures usual meal patterns, whereas the other dietary assessment methods do not.

Table 12. Limitations of Dietary Assessment Methods[5,121]

24-Hour Recall	• Reliant on respondent memory • Not representative of usual intake • Relies on self-report • Data entry is labor intensive • Susceptible to under- and over-reporting • Language may be a barrier
FFQ	• Time-consuming • May not capture usual foods eaten • Does not assess meal patterning • Reliant on respondent description of diet • Does not estimate absolute intake of individuals
Food Record	• High respondent burden • Relies on self-report • Time-consuming • Act of recording may alter diet • Requires respondent literacy • Analysis is labor intensive and expensive
DHQ	• Reliant on respondent memory • Time consuming • Requires highly skilled interviewers • Data entry is labor intensive and expensive

A timeline approach has been considered in other areas of research, but has not yet been tried with dietary intake. For example, in the medical field, Bui et al. developed a multimedia timeline capturing patient medical records to facilitate physician services and decision making.[122-124] Panton et al. developed a graphic timeline tool depicting treatment courses for parents of children with retinoblastoma in order to communicate more effectively the treatment options and their risks.[125] In substance abuse research, the Timeline Followback method is used to retrospectively assess recent drinking behavior.[126] In this study, the timeline approach lent itself well to capturing the usual eating patterns of adolescent African Americans and was useful for making comparisons by gender and HTN risk groups.

The MPTs of the four risk-gender groups examined were distinctive and allowed for the characterization of typical MPTs for each group. Most participants skipped breakfast half of the time, except for high-risk females who only skipped breakfast a quarter of the time. Research indicates that breakfast is skipped more often than any other meal[87,88] and that adolescents who eat breakfast have superior nutrient intakes compared to peers who skip breakfast.[85-90] Eating breakfast has also been related to improved cognitive functioning, academic performance, and attendance at school.[87-90] Given these findings and that African American adolescents are more likely to skip breakfast than white counterparts,[86-89] eating breakfast is a meal pattern that must be strongly promoted to African American youth to improve diet quality. However, in this study, although high-risk females ate breakfast more often than all other risk-gender groups, they tended to consume unhealthful breakfasts such as sausage biscuits,

doughnuts, and toaster pastries. Nicklas et al. reported that African American youth consumed greater amounts of fat, saturated fat, sodium, and cholesterol in their breakfasts as compared to whites.[85] Thus, not only should breakfast be encouraged among black adolescents, it is imperative that selection of nutrient-dense foods be emphasized.

The majority of the time, participants in this study ate unhealthful lunches, often from school cafeterias, consisting of pizza, hamburgers, or corn dogs with French fries. Healthful lunches were rare, although low-risk participants were more likely than high-risk to choose moderately healthful options such as peanut butter and jelly or grilled cheese sandwiches. Nutrition quality of school foods has become an increasing concern, especially due to "a la carte" items and "competitive foods."[127-129] Increased availability of these items has been associated with increased frequency of purchase and consumption among adolescents.[128,129] This translates into higher intakes of total energy, soft drinks, fat, and saturated fat and lower intakes of fruits, vegetables, milk, and essential vitamins and minerals.[128,129] Environmental school policy changes are needed to increase the availability of nutrient-dense foods and decrease availability of energy- and sodium-dense "a la carte items" and "competitive foods." These policies should also address open campus lunch hours and limit the times during the day when vending machines are turned on, which have been associated with increased consumption of fast food, and soft drink purchases, respectively.[130]

A pilot intervention study by Cullen et al. in 2004 indicated that healthful changes (lower-fat entrees, increased availability of fresh fruits and vegetables and bottle water, and reduced portion sizes of snack chips and sweetened beverages) made in the cafeterias

of six middle schools in three states over a six-week period were acceptable to students and staff.[131] Other school nutrition interventions have shown the same feasibility and have not resulted in decreased revenues.[128]

Finally, Neumark-Sztainer et al. reported that high school students in a large cross-sectional study brought lunch from home an average of once per week.[130] Thus, encouraging students to bring healthful lunches from home more frequently is another strategy for improving the quality of the lunch time meal, which may be easier to implement and have more immediate outcomes than waiting for policy changes to be established and take effect. Students also need instruction on choosing the most healthful options when dining in school cafeterias and fast food restaurants.

Compared to high-risk participants, low-risk participants more often ate home-cooked dinners with family and included vegetables. Low-risk males consumed healthful dinners the most frequently and high-risk males most often consumed dinners that were eaten away from the home at fast food restaurants or consisted of fried meats, frozen foods, or snack foods. At-risk youth should be encouraged to eat more dinners with family as research clearly indicates a positive impact of family meals on the quality of the adolescent diet. Intake of fruits, vegetables, whole grains, dairy foods, fiber, and essential vitamins and minerals increases as frequency of family meals increases.[44-47,49] At the same time, intake of soft drinks, fried foods, saturated fat, trans fat, and high glycemic foods decreases.[45-47,49] Furthermore, as family meal frequency increases, adolescents are less likely to consume frozen dinners, canned foods, and microwave meals, which were hallmarks of the unhealthy dinners eaten by high-risk participants in

this study.[44, 45,47,49] Family dinners may provide adolescents with increased exposure to healthful foods, parental modeling of healthful eating behaviors, and educational conversation on nutrition.[56,57]

Although increasing the frequency of family dinners among adolescent African Americans would likely contribute to improved dinner quality, many families have busy and/or conflicting schedules that preclude eating more frequently as a unit.[49,56,57] Furthermore, throughout the transition from adolescence to young adulthood, youth become more and more responsible for acquiring and preparing their own meals.[49] As such, other approaches to getting adolescents to consume healthful dinners are needed, such as encouraging teens to eat out less, promoting restaurants where healthful entrees can be purchased, educating teens on how to choose the healthiest options on a menu when eating out or on the go, teaching youth how to make quick, tasty, low-cost, healthful dinners, and helping them identify the healthiest types of quick, frozen, or convenience items to have on hand for when they are pressed for time or do not want to cook. These strategies may result in benefits similar to eating dinner with the family and might be more practical for many adolescents.

Most participants ate one snack per day, with low-risk participants being more likely than high-risk participants to snack multiple times per day. Across all risk-gender groups, most snack choices were cookies, candy, and chips, although low-risk participants (especially females) were more likely than high-risk participants to choose fruit, cereal, or popcorn. These findings are consistent with the literature which indicates that the most popular snack food choices for adolescents are potato chips pretzels,

popcorn, candy, cookies, ice cream, and cakes.[95-98] Addressing the quality of adolescents' snacks is important given that teens may derive up to 25% of their total daily energy intake from snacks.[95,96,100,102,104-106] Additionally, the consumption of salty snack foods appears to be increasing among youth[95,97,99] which is concerning given the known association between sodium intake and blood pressure.[32,91] In order to improve adolescents' snack choices, research suggests that healthy alternatives must taste good, be filling, of good value, and fresh. These characteristics have been cited as the most the influential factors on snack choices of youth.[96,98]

Participants drank on average three beverages per day. Low-risk participants chose flavored milk, 100% fruit juice, and diet sodas rather than regular sodas, fruit drinks, and sweet tea, which high-risk participants chose more often. All participants chose water and low-fat milk only about a quarter of the time. As beverages may provide up to 20% of total daily energy in the adolescent diet, beverage choice can have a significant impact on an adolescent's dietary quality and nutritional intake.[78] The high frequency of sweetened beverage consumption is not only alarming due to the resulting intake of excess calories from sugar and displacement of milk in the diet,[80,82] but also because sodas and sweet tea, containing 20-30 mg of caffeine per 8 oz,[132] may increase daily caffeine intake. Savoca et al. reported in 2004 that a higher intake of caffeine was related to higher SBP among black adolescents.[133]

Two common misconceptions regarding beverages were evident among the study population. First, many participants reported drinking fruit juice, but when probed further actually described fruit drinks. For example, Sunny Delight was considered the

same beverage as Orange Juice. Second, a number of male participants reported drinking sports drinks such as Gatorade and Powerade throughout the day to help improve sports performance. These drinks are meant to replenish carbohydrate and electrolyte stores after an hour or more of continuous activity. Thus, both fruit drinks and sports drinks are contributing to excess empty caloric intake throughout the day, although consumers believe that they are making healthy beverage choices. These prevalent misconceptions need to be communicated to adolescents so that when choosing to consume a healthful beverage, the decision is an educated one.

Meal patterns identified from participants' MPTs that were related to intake of DASH diet components were used as variables in an exploratory principal components/factor analysis, which generated six factors: *Healthy Dinner*, *Healthy Lunch, Unhealthy Snacks*, *Skipped Breakfast, Unhealthy Beverages*, and *Healthy Snacks*. The factors *Healthy Lunch, Unhealthy Snacks, Skipped Breakfast*, and Unhealthy *Beverages* statistically significantly predicted SBP; *Unhealthy Snacks* and *Unhealthy Beverages* predicted DBP with marginal significance; and *Healthy Dinner* and *Skipped Breakfast* statistically significantly predicted BMI. Higher factor scores for *Healthy Lunch, Healthy Dinner,* and *Skipped Breakfast* were related to more desirable clinical outcomes, whereas lower factor scores for *Unhealthy Snacks* and *Unhealthy Beverages* were related to more desirable clinical outcomes. It is not surprising that with increased frequency of eating healthful lunches and dinners and with decreased frequency of eating unhealthful snacks and beverages, decreases in blood pressure and BMI were seen. It is somewhat counterintuitive that a higher frequency of skipping breakfast was related to a

lower SBP and BMI. However, this finding likely reflects the choice of unhealthful breakfasts when this meal is indeed eaten. By skipping breakfast adolescents may be avoiding the addition of extra calories, salt, and fat into the diet, when their choice of foods otherwise would be highly processed or fast foods.

These results demonstrate that African American adolescents' meal patterns are related to SBP, DBP, and BMI, important clinical parameters that set the stage for the disproportionate burden of early onset HTN among this population. This research suggests that by modifying meal patterns, clinical measures may be favorably altered as to positively impact future health and reduce HTN risk. To date, very little research has been conducted among adolescents that addresses dietary approaches to preventing HTN, even though as many as 8.1% of adolescents may be hypertensive,[14] up to 15.7% may be pre-hypertensive,[10] and studies show that elevated blood pressure in youth tracks into adulthood.[27,28,134] Furthermore, as in adults, the prevalence of HTN and prehypertension is greater among African Americans as compared to whites.[1,10,16,17] The DASH diet has been shown to be a very effective approach to reducing and controlling blood pressure among adults.[19,20,32] However, only three studies to date have examined the relationship between diet and blood pressure in adolescents.[21-23]

In 2005, Moore et al. reviewed eight years of longitudinal data on 95 children, ages 3-6 at enrollment.[21] Participants who consumed at least four servings of fruits and vegetables per day and at least two servings of dairy per day displayed the smallest yearly increases in SBP and had the lowest blood pressure by early adolescence. Conversely, participants who consumed less than four servings per day of fruits and vegetables and

less than two servings per day of dairy displayed the largest yearly increases in SBP and had the highest blood pressure by early adolescence. In 2004, Falkner et al. reported that among 14-16 year-olds at high-risk for HTN, higher blood pressure readings were obtained for those with low fruit and vegetable intake.[22] Additionally, those with low fruit and vegetable intake also had higher intakes of energy and sodium, and lower daily intakes of potassium, calcium, and magnesium. Finally, D'Adessa et al. reported greater intake of energy, cholesterol, meat, ham, salami, and cheese among hypertensive adolescents as compared to normotensive counterparts.[23]

These studies clearly indicate a relationship between diet and blood pressure among youth. They also suggest that DASH diet components that have been pivotal for adult management of HTN (i.e. fruits, vegetables, dairy, calcium, magnesium, potassium, cholesterol, fat, and sodium) may also pertain to younger populations. To date, no HTN interventions have been conducted in an adolescent population. However, in order to reduce the prevalence of HTN among adults, prevention and intervention programs for at-risk youth are critically needed. This research has distinguished meal patterns between African American adolescents of differing HTN risk profiles and identified meal patterns that are related to intake of DASH diet components, SBP, DBP, and BMI. More research is needed to confirm these relationships and to develop interventions that incorporate strategies to modify key meal patterns among African American youth. By effectively targeting specific meal patterns, intake of key DASH diet components can be changed, thus helping to reduce and control blood pressure, ultimately diminishing the disproportionate HTN burden among African Americans.

Strengths and Limitations

The design of this study was a strength that allowed for comparison of meal patterns between African American adolescents at high-risk and those at low risk of developing early onset HTN. The use of in-depth interviews as the primary method of data collection allowed for a rich data set that was not restricted to pre-determined responses. Finally, in the social sciences, a factor analysis solution that accounts for 60% of the total variance is satisfactory;[135] the six-factor solution described in these results explained 81.23% of the total variance.

This study also had some limitations. The MPT is a novel approach to differentiating dietary behavior between groups and for facilitating dietary change that has not been previously validated. It is unknown whether an individual's MPT is stable over time or merely represents the recent dietary habits of an individual. Furthermore, the MPTs were constructed based on participant self-report and it was thus assumed that participants gave truthful examples of usual dietary patterns and did not provide false information based on social desirability. Additionally, relatively broad guidelines were used to classify the foods and beverages consumed by participants as healthful, moderately healthful, or unhealthful. A stricter, more objective classification system based on how well foods and beverages comply with the DASH diet would make this part of the process more systematic.

Other limitations include the small, self-selected sample and the lack of sub-group analysis for Aim 3. As such, results may not be generalizable to other populations and statistically significant findings by sub-group may have gone undetected. Finally,

although it is best to have at least five times as many observations as variables to be analyzed in a factor analysis,[135] the exploratory analysis run in this study, provided only a 3:1 ratio (20 variables and 58 observations).

Future Implications

The MPT is a practical approach to assessing dietary patterns and facilitating dietary behavior change among adolescents. Future research will further refine the procedure and test the validity and reliability of the instrument. The effectiveness of dietary counseling through the use of the MPT on dietary behavior change will also need to be studied.

More research is needed to see if the meal pattern variables derived from participants' MPTs in this study result in the same factor solution when applied to other groups of African American adolescents and if the solution consistently predicts SBP, DBP, and BMI. It is likely that with a more refined MPT tool, new meal patterns, more specific to the DASH diet (i.e. "drinks milk daily" or "eats fruit more than twice per day") may yield a new solution that better predicts clinical outcome measures.

It would also be interesting to test the functionality of the MPT with populations of other ages, ethnicities, and risk factors. Although the meal patterns identified in this research may apply to other chronic diseases, new meal pattern variables may be uncovered that specifically relate to other conditions (i.e. diabetes mellitus, metabolic syndrome, CVD).

The optimal format for the MPT would likely be computer based, making it suitable for large-scale, tailored interventions. Such a multimedia format would allow

widespread access through both the internet and strategically placed kiosks, reaching millions more than a traditional intervention program ever could.

CHAPTER VI

EPILOGUE

The Master's thesis has been one of the greatest challenges that I have faced to date. Previous academic coursework, employment experiences, personal growth endeavors, and physical tests of intestinal fortitude pale in comparison to the level of complex thinking necessitated and degree of exertion demanded to complete the Master's thesis. If all I had been required to do was complete an Ironman triathlon, getting my degree would have been easy. Conversely, the arduous and at times painstakingly slow experience was one of both great intellectual and personal development.

The type of work and thinking required to complete the Master's thesis was different from that which I have done before. First of all, when I started the thesis, like most undergraduate students, I was accustomed to being given an assignment and then completing it. This type of linear work is accomplished by simply following directions; even a computer can do this. On the other hand, the Master's thesis required creating my own assignment and set of directions. Unfortunately, the directions contained many wrong turns and stop signs, and there were no short cuts. I had to continually reevaluate and evolve my ideas in order to navigate my path to the end. The work was anything but linear and required a lot of critical thinking, careful decision making, and creativity. Furthermore, my undergraduate background is in mathematics and computer science, which are two very "black and white," quantitative disciplines. Learning how to

qualitatively analyze data was a new experience for me that was difficult because I kept wanting to reduce the data to numbers.

Unlike most of my past academic pursuits, there were many times during this process when I felt completely overwhelmed and I questioned whether or not I could actually finish the work. It was during such times that I sought advice from Dr. Savoca. Somehow I always came out of our meetings feeling reenergized and confident about the project, all of my doubts left behind in her office. I learned two important lessons. First, that the skillful art of good mentorship is invaluable. Without Dr. Savoca's guidance and astute insight I would never have been able to accomplish all that I have. She knows the precise quantities of camaraderie, encouragement, coaxing, pushing, and stretching called for in the recipe of success. Second, I learned that I have the inner strength to persevere when times get tough and not to question my abilities.

Although the work was in many ways different and more challenging than my prior experiences in academia, it was also more rewarding. I learned an incredible amount not only about hypertension and adolescent meal patterns, but also about the research process in general and technical writing abilities needed to communicate with other professionals in the field. I have a better appreciation for a well-written peer-reviewed paper because I now know how much time and effort goes into preparing a relevant literature review, clearly describing methodology and results, synthesizing all knowledge into a meaningful conclusion, and then consolidating it all into an abstract. The completion of this Master's thesis work is one of my proudest accomplishments thus far in life.

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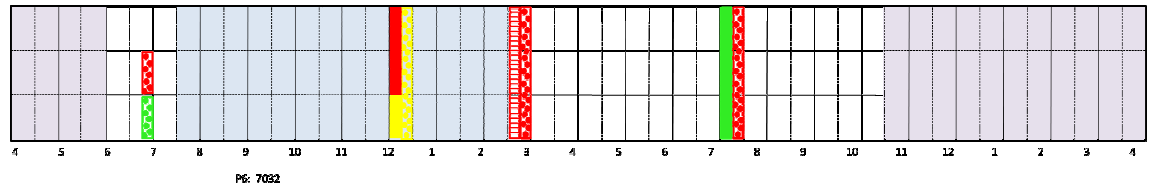
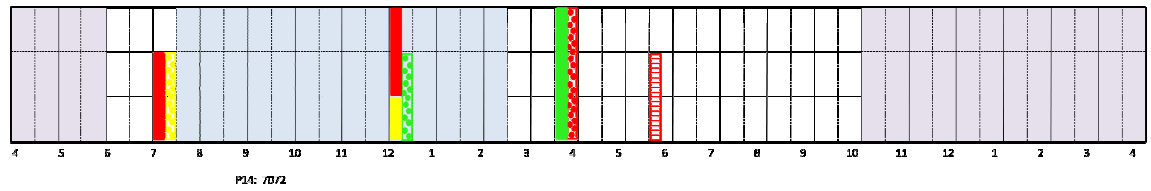
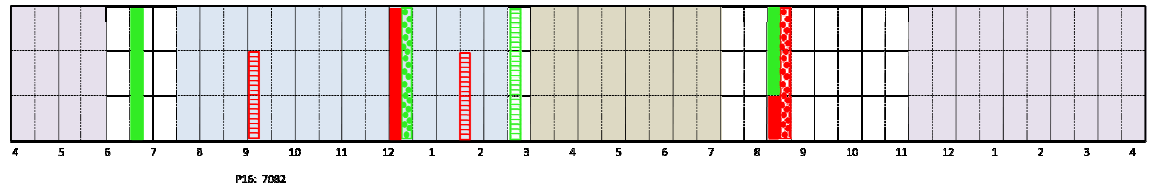
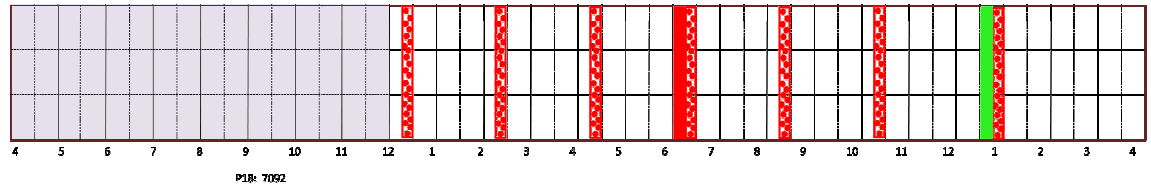
APPENDIX A. MEAL PATTERN TIMELINES OF ALL PARTICIPANTS

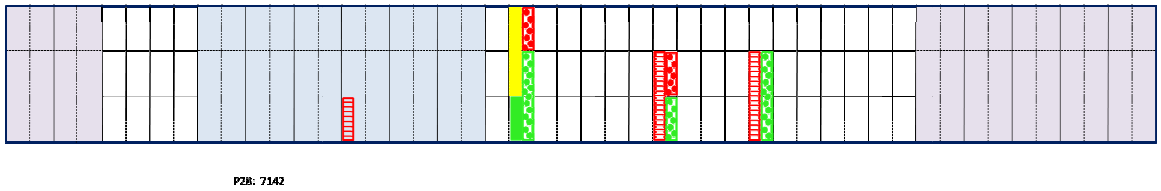
High-Risk Males

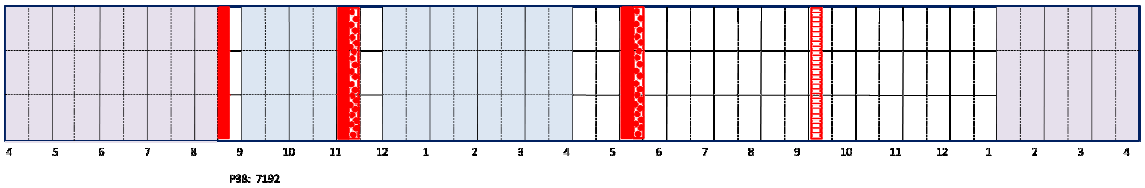








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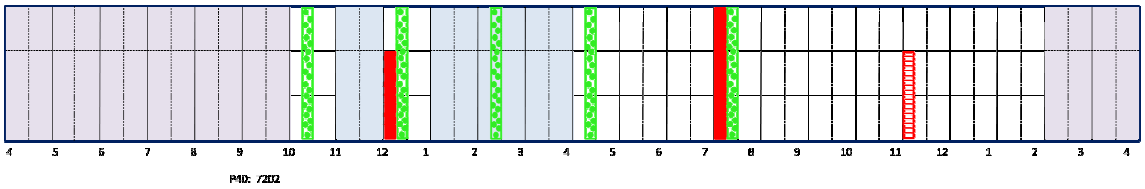
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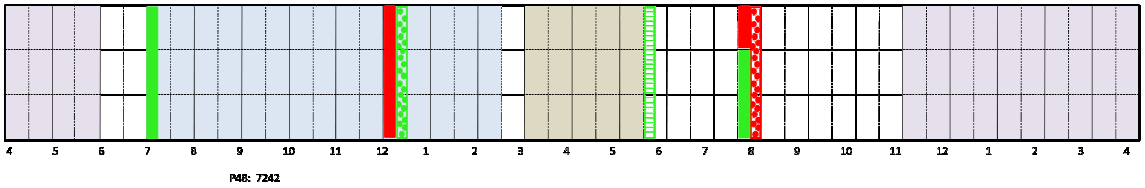
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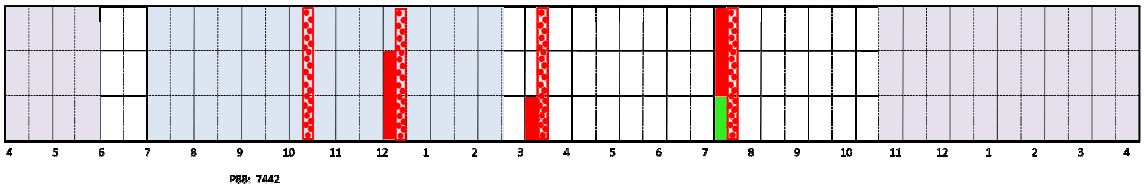
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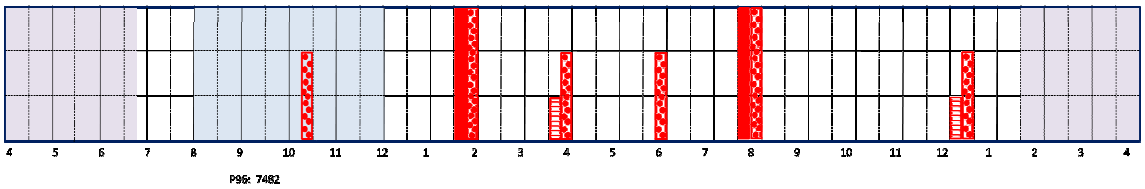
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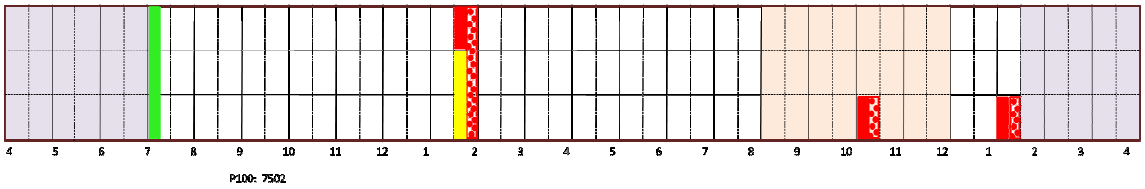
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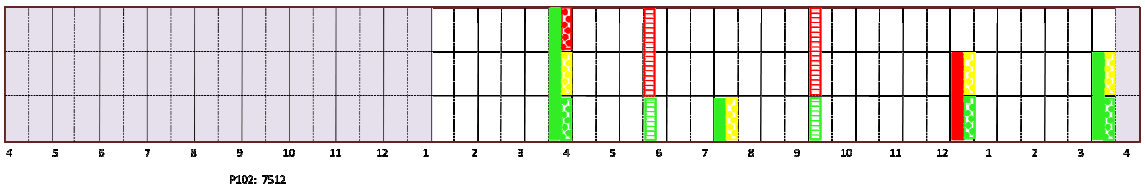
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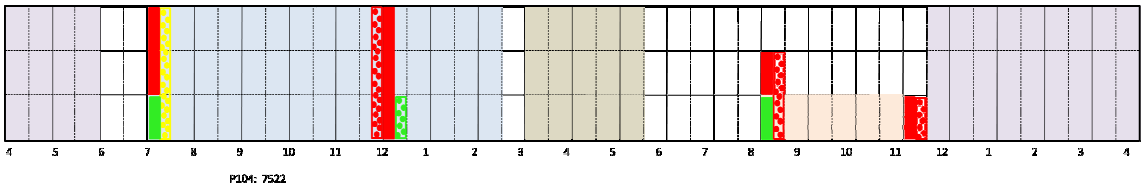

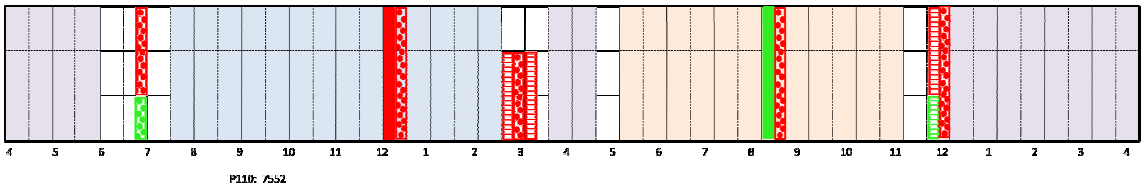

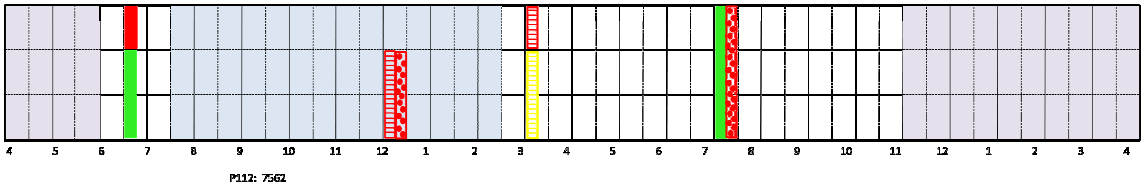

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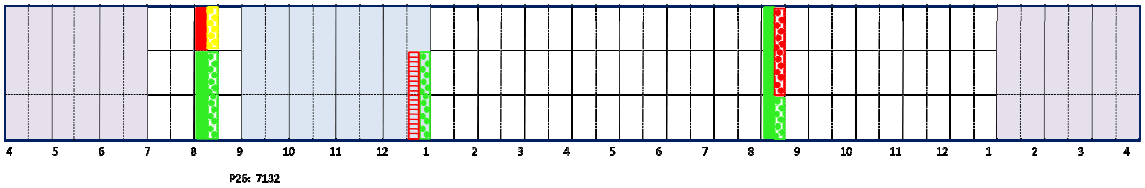

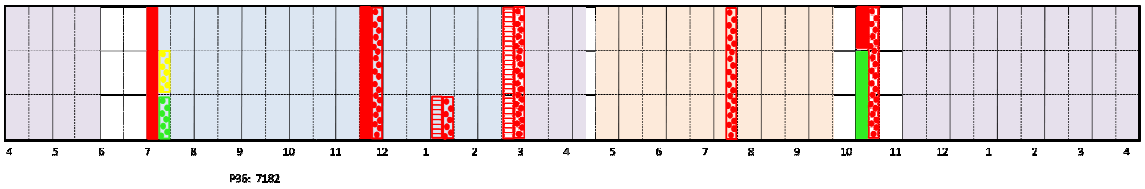

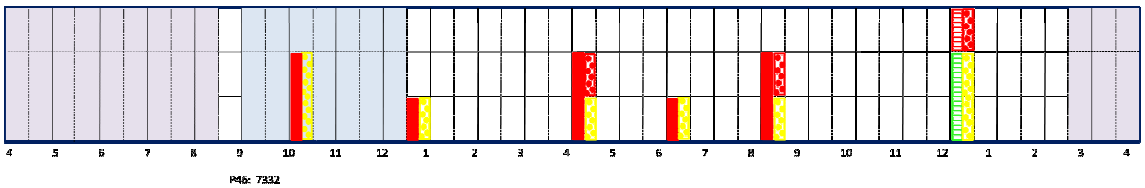

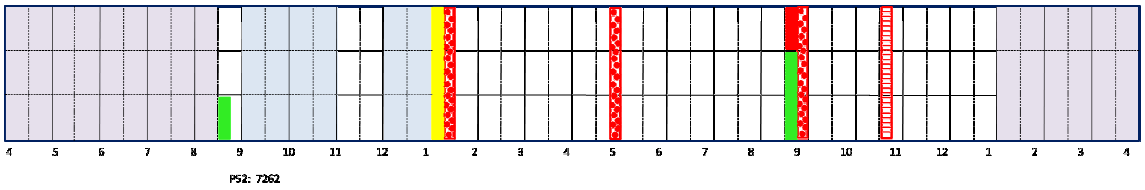
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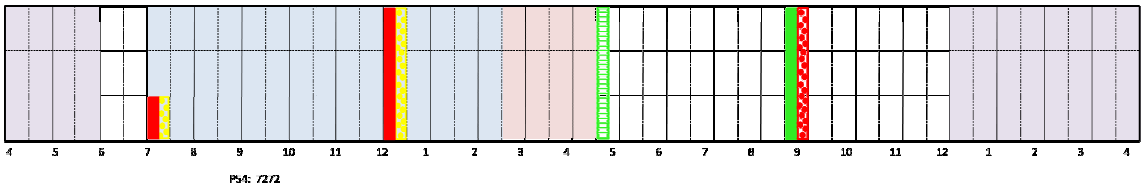
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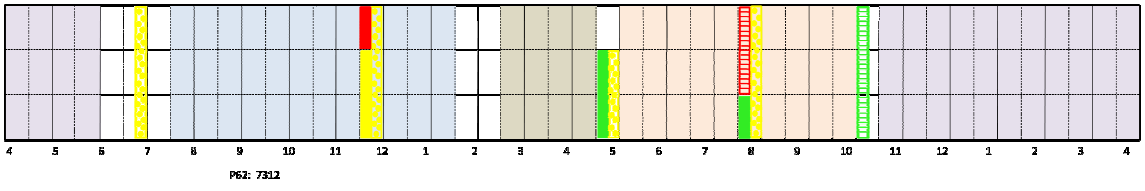
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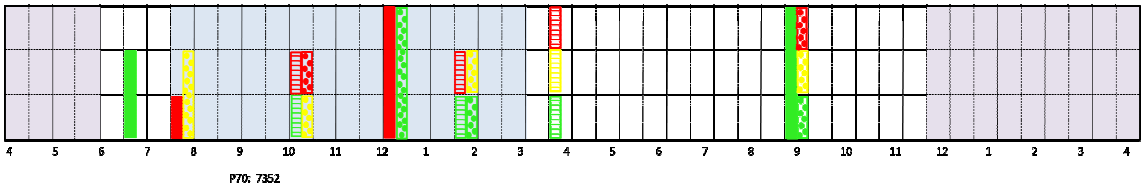
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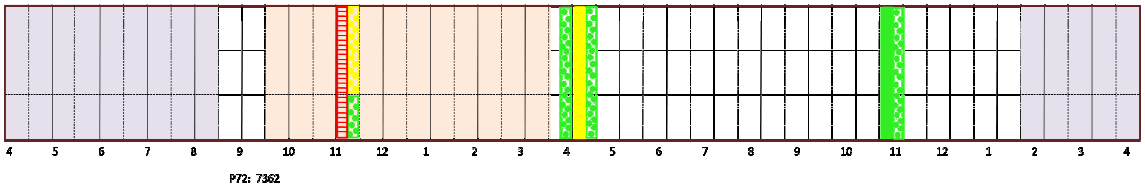
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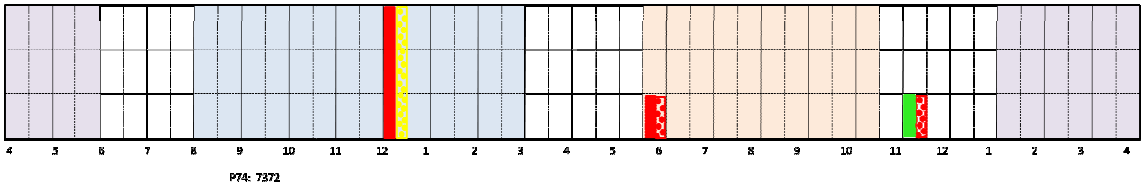
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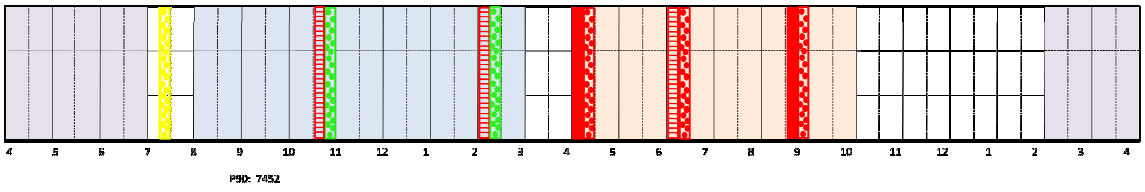
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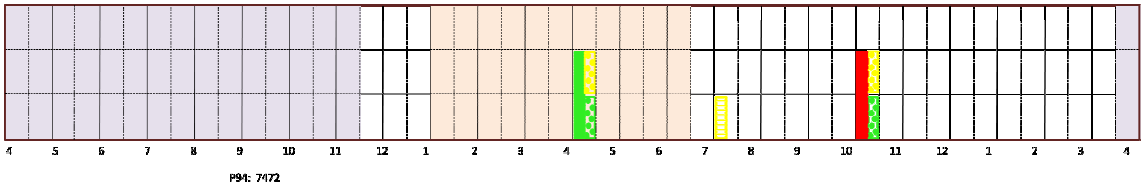

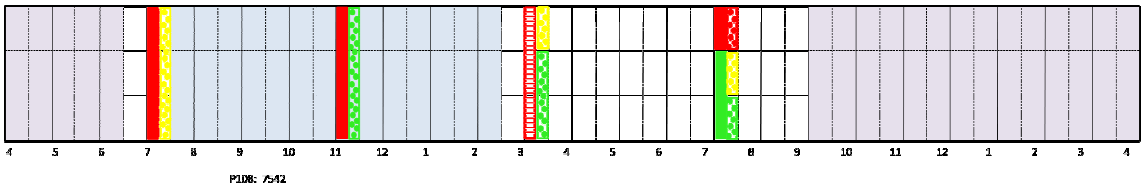

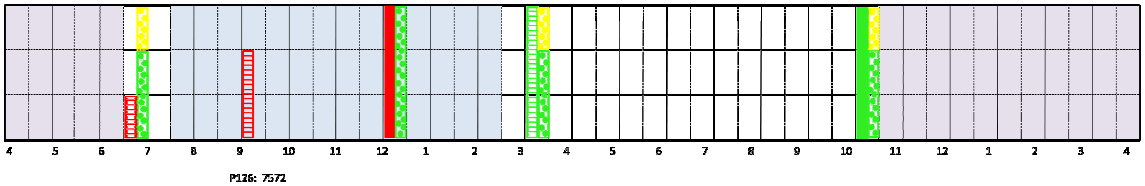

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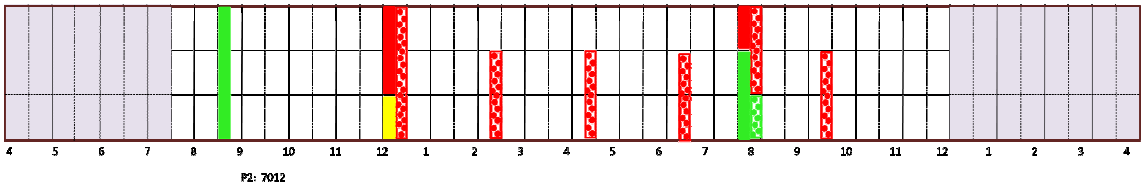

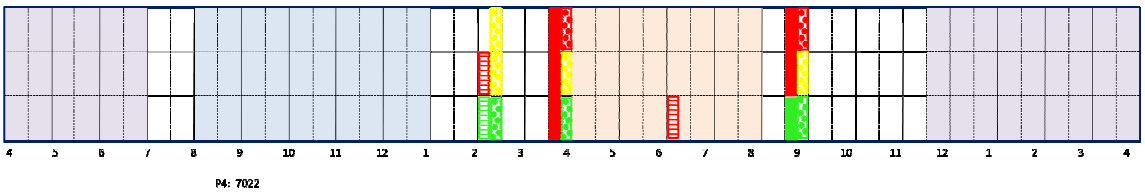

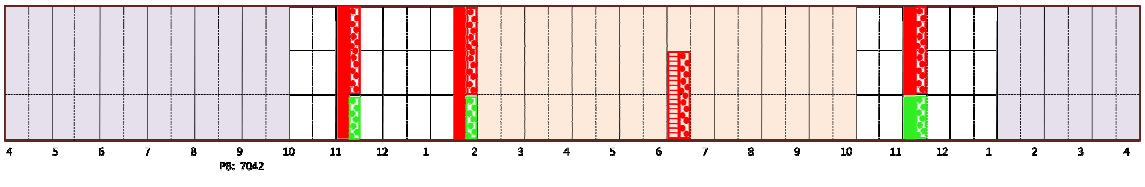

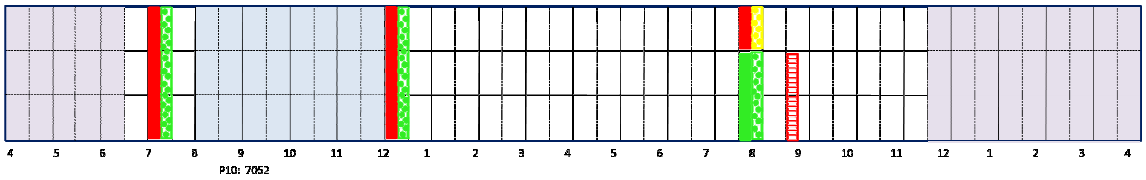
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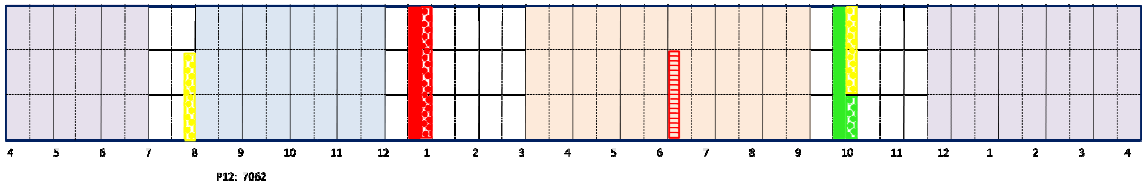
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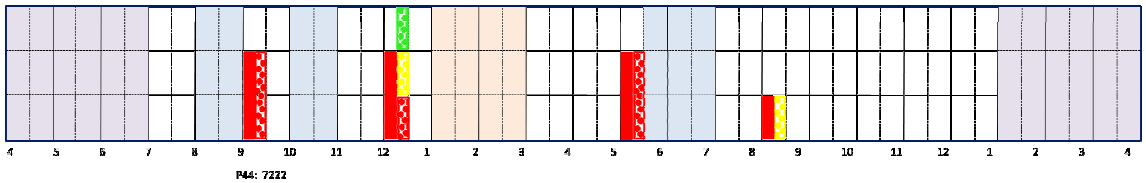
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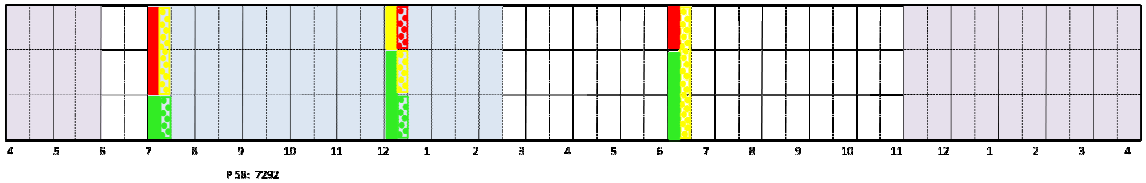
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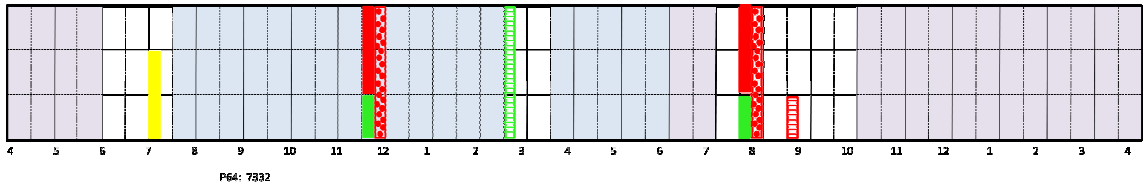
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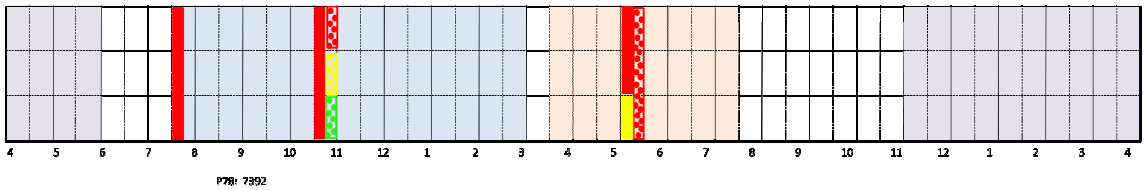
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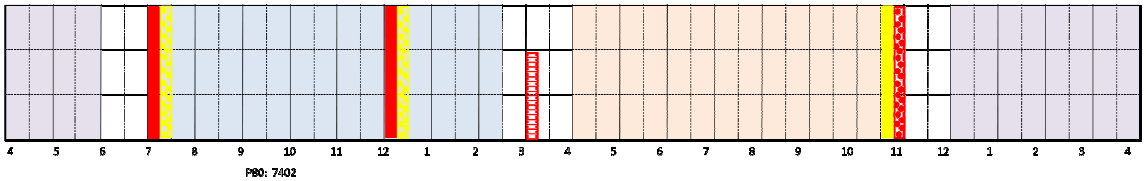
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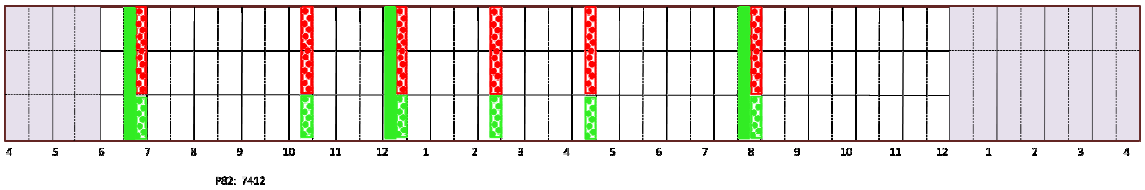

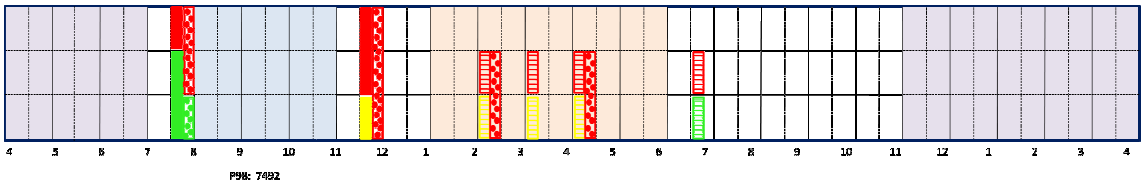

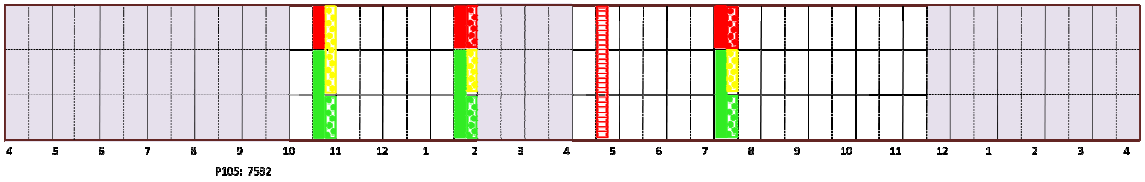

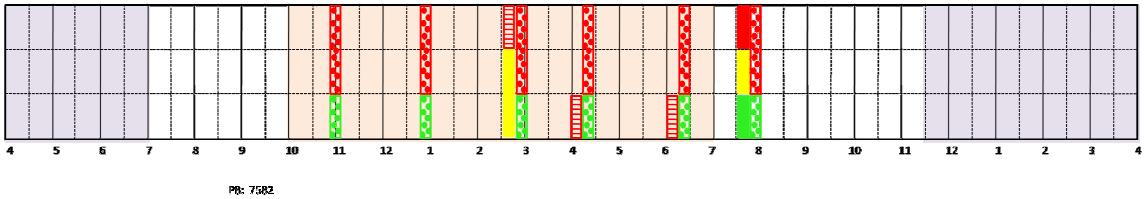

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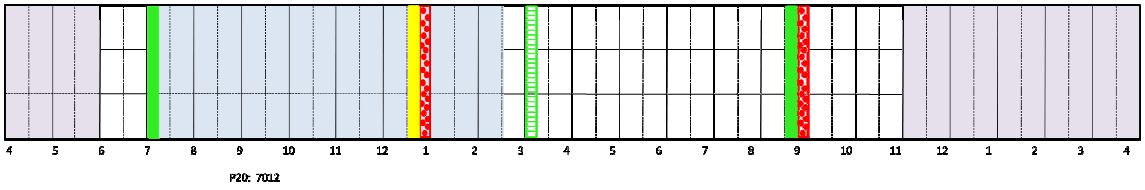

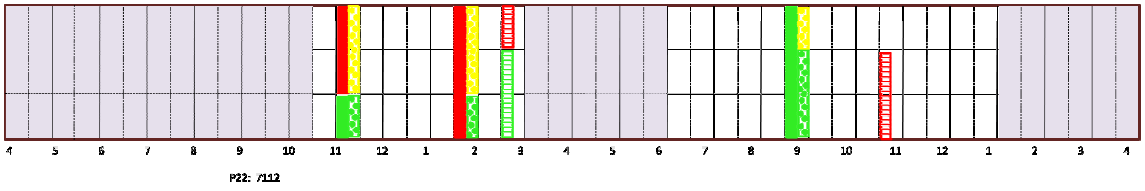

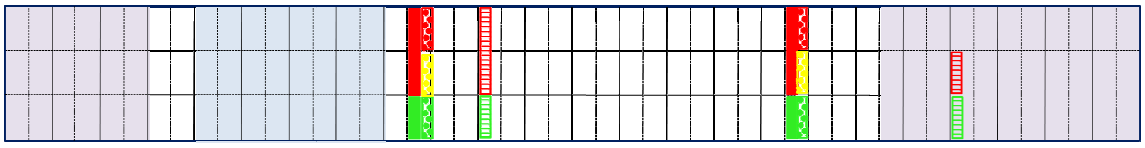

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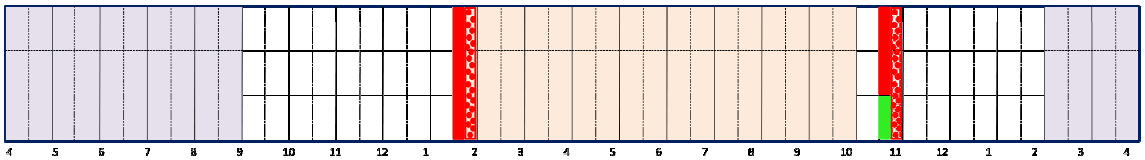

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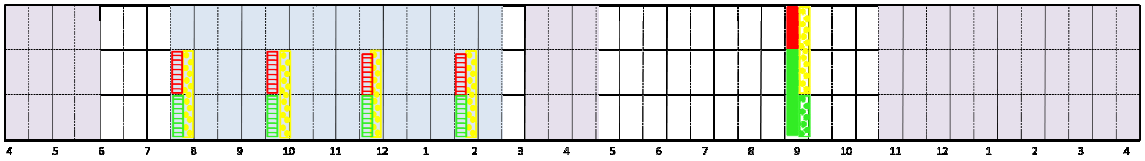

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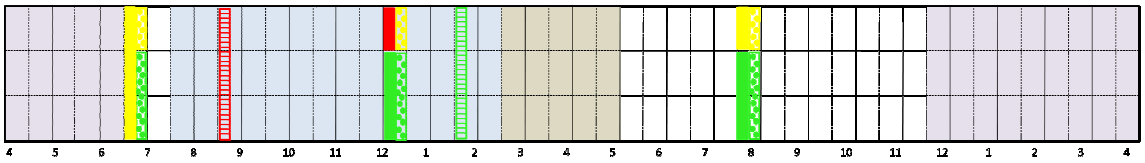

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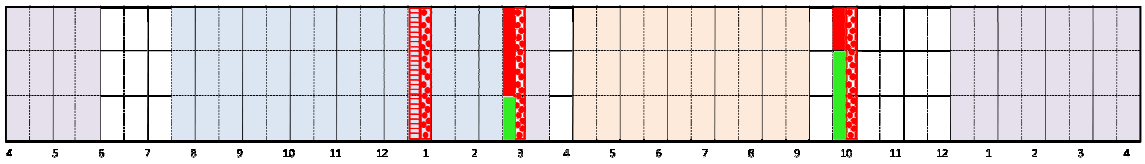

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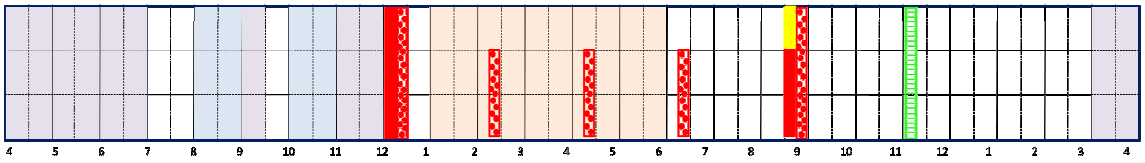

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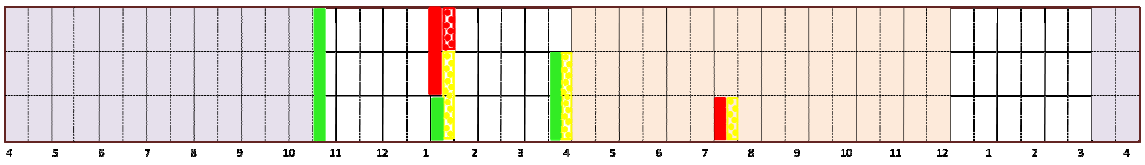

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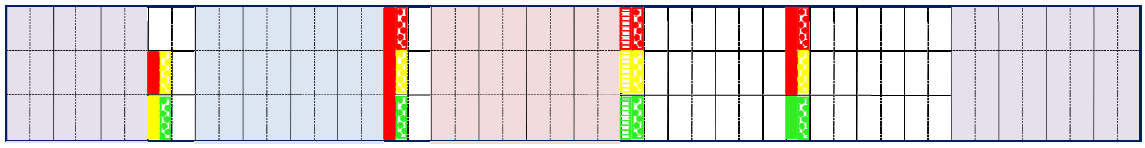

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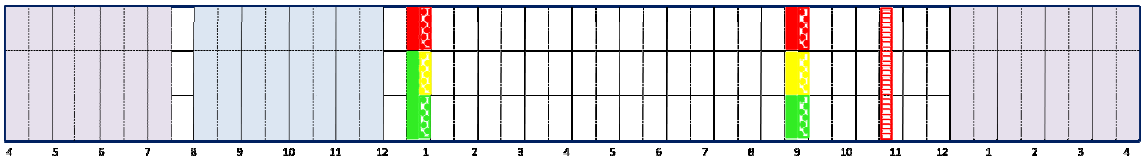

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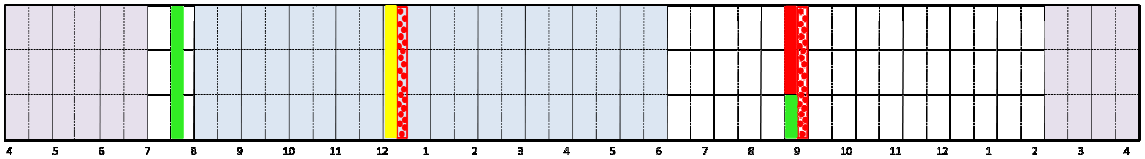

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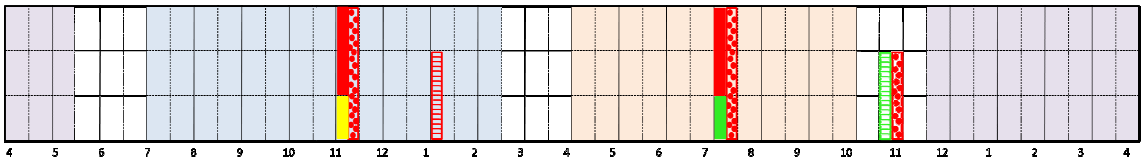

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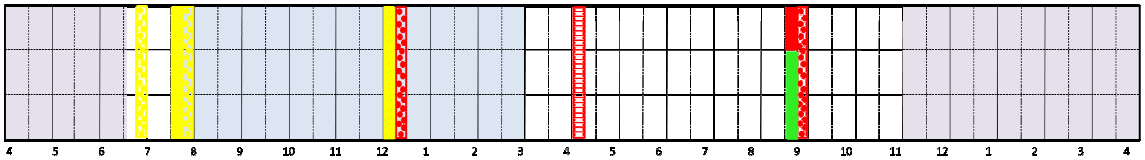

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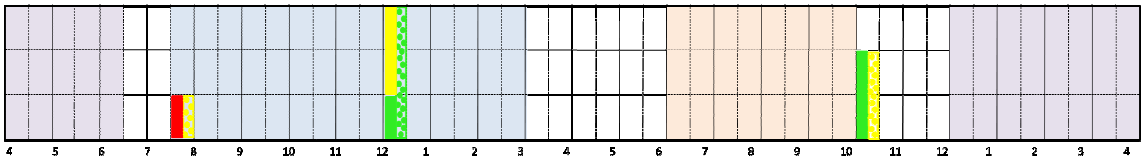

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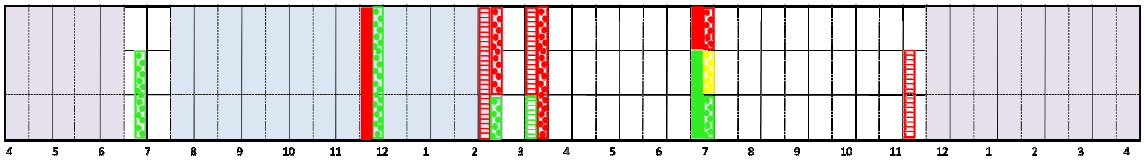
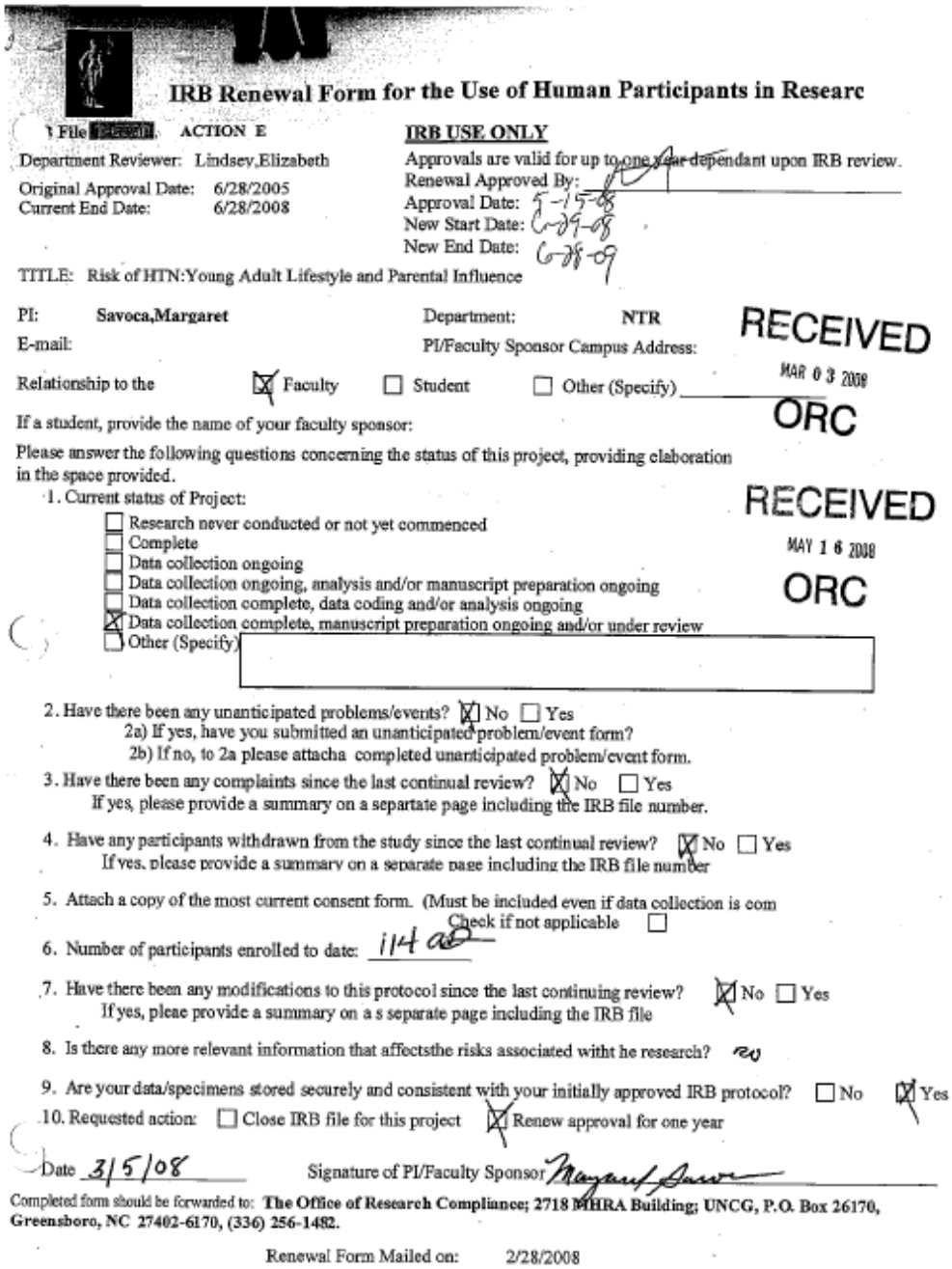


P92: 7462

APPENDIX B. IRB APPROVAL & CONSENT DOCUMENTS

UNCG IRB Approval



IRB Renewal Form for the Use of Human Participants in Researc

File [redacted] ACTION E

Department Reviewer: Lindsey,Elizabeth
Original Approval Date: 6/28/2005
Current End Date: 6/28/2008

IRB USE ONLY
Approvals are valid for up to one year dependant upon IRB review.
Renewal Approved By:
Approval Date: 5-15-08
New Start Date: 6-29-08
New End Date: 6-28-09

TITLE: Risk of HTN:Young Adult Lifestyle and Parental Influence

PI: **Savoca,Margaret** Department: **NTR**
E-mail: PI/Faculty Sponsor Campus Address:

RECEIVED MAR 0 3 2008 ORC

Relationship to the ☒ Faculty ☐ Student ☐ Other (Specify)
If a student, provide the name of your faculty sponsor:

Please answer the following questions concerning the status of this project, providing elaboration in the space provided.

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1. Current status of Project:
   - ☐ Research never conducted or not yet commenced
   - ☐ Complete
   - ☐ Data collection ongoing
   - ☐ Data collection ongoing, analysis and/or manuscript preparation ongoing
   - ☐ Data collection complete, data coding and/or analysis ongoing
   - ☒ Data collection complete, manuscript preparation ongoing and/or under review
   - ☐ Other (Specify)

2. Have there been any unanticipated problems/events? ☒ No ☐ Yes
   2a) If yes, have you submitted an unanticipated problem/event form?
   2b) If no, to 2a please attacha completed unanticipated problem/event form.
3. Have there been any complaints since the last continual review? ☒ No ☐ Yes
   If yes, please provide a summary on a separtate page including the IRB file number.
4. Have any participants withdrawn from the study since the last continual review? ☒ No ☐ Yes
   If yes, please provide a summary on a separate page including the IRB file number
5. Attach a copy of the most current consent form. (Must be included even if data collection is com
   Check if not applicable ☐
6. Number of participants enrolled to date: 114
7. Have there been any modifications to this protocol since the last continuing review? ☒ No ☐ Yes
   If yes, plese provide a summary on a s separate page including the IRB file
8. Is there any more relevant information that affectsthe risks associated witht he research? no
9. Are your data/specimens stored securely and consistent with your initially approved IRB protocol? ☐ No ☒ Yes
10. Requested action: ☐ Close IRB file for this project ☒ Renew approval for one year

Date 3/5/08 Signature of PI/Faculty Sponsor

Completed form should be forwarded to: **The Office of Research Compliance; 2718 MHRA Building; UNCG, P.O. Box 26170, Greensboro, NC 27402-6170, (336) 256-1482.**

Renewal Form Mailed on: 2/28/2008

Parental Consent Document

Subject's Name: _____

Georgia Institute for the
Prevention of Human Disease and Accidents
Department of Pediatrics

PARENTAL CONSENT DOCUMENT

Risk of HTN: Young Adult Lifestyles & Parental Influence

Principal Investigator: Margaret R. Savoca, Ph.D.
Sub-Investigator: Gregory Harshfield, Ph.D.
Frank Treiber, Ph.D.
Conner Evans

INVITATION TO PARTICIPATE:

My child and I have been invited to participate in a research study. This study will look at how young adults and their mothers understand hypertension (high blood pressure) and lifestyle activities, such as eating and exercise. We have been asked to take part in this study because my child is African-American, 17-20 years of age, and a past participant in one of Dr. Harshfield's studies at the Georgia Prevention Institute. My child will be one of 60 young adults and I will be one of 60 mothers to participate in this study.

PROCEDURES:

If we participate in this study then we would meet with the researcher, Dr. Savoca. This meeting will last about two hours. During this time, the researcher will take me into a private room so that she can interview me. She will ask me some questions about my views on high blood pressure and its development. She will also ask me about our current and past activities, such as eating and exercise. The interview will take about one hour. During the interview, my child will remain in another private room so that a research assistant can ask him/her some questions about our family background and medical history. He/she will also fill-out a diet history questionnaire. When the researcher is finished talking with me then Dr. Savoca will interview my child. Dr. Savoca will ask my child the same or similar questions that she asked me. While my child is being interviewed, I will answer some questions about our background/medical history and fill-out a diet history questionnaire. At any time during the interview or the questionnaire session, my child and I can refuse to answer any of the questions. Dr. Savoca or the research assistant will skip that question and move to the next topic or question.

Before the interviews begin, Dr. Savoca and the research assistant will measure my child's and my blood pressure, weight, and height.

HAC FILE # 04-04-345
HAC APPROVED INFORMED CONSENT DOCUMENT
APPROVAL FROM 5/12/04 TO 4/28/05
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Parent/ Guardian's Initials _____

Subject's Name: _____

Our interviews with the researcher will be recorded on audio cassette tapes that only Dr. Savoca and the research assistant will get to hear. At any point during taping, my child or I can ask that taping be stopped. The tape recorder will not be turned back on unless I or my child gives the permission to do so.

Dr. Savoca and the RA will transcribe (write down) all of the information that they collect on each tape. We will not be identified by name in these transcripts. Dr. Savoca will destroy our cassette tapes as soon as she has finished the transcripts. Other researchers will not listen to the tapes or read the transcripts. The transcripts will only be used to learn about how all the children and their parents answered the questions. A general summary of the results for all participants will be prepared. Only this general summary will be provided to other researchers.

Sometimes when people are interviewed for a research project, short summaries of the interviews are used to help people understand the results. If the interviews of my child and me are summarized, any information that might identify us will be changed. That is names, occupations, or events will be changed so that a reader will not recognize us from what is written.

COSTS:
I will be responsible for the costs of transportation to GPI and MCG.

SUBJECT PAYMENT:
My child and I will each receive a $50.00 check in the mail after we complete the interview and the background/diet history questionnaires.

RISKS AND/OR DISCOMFORTS:
There are no risks or discomforts involved in this study. We do not have to answer any questions that make us feel uncomfortable.

POSSIBLE BENEFITS:
We may not personally benefit from this study. Our participation in this study may provide important information regarding future prevention and treatment of hypertension in African American teenagers.

ALTERNATIVE TREATMENTS:
The only alternative for this study is to not participate.

COMPENSATION:
While no harm should be expected from our participation in the study, I understand that the Medical College of Georgia assumes no obligation to pay any money or provide free medical care in case this project results in any harm to my child or my self.

QUESTIONS:
If I have any questions about the study procedures or about our participation in this study, I may contact Dr. Margaret Savoca at (706) 721-5426. If I have any questions or

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HAC APPROVED INFORMED CONSENT DOCUMENT
APPROVAL FROM 5/10/04 TO 4/25/05.
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Parent/ Guardian's Initials _____

Subject's Name: _____

concerns about the "rights of research subjects", I may contact the Chairman of the Human Assurance Committee, Dr. George S. Schuster at (706) 721-2991.

VOLUNTARY PARTICIPATION:
My participation in this study is voluntary. I may revoke my consent and withdraw us from the study now or at any time in the future without penalty or loss of care or other benefits to which my child is otherwise entitled. I can do this by telling a member of the study team that I want to stop participating. I understand that my refusal to participate in this study will not prevent my participation in other studies at this institution.

PRIVACY NOTICE:
The researchers are asking for my written authorization before using my child's or my health information or sharing it with others in order to conduct the research described. However, under certain circumstances, the researchers may use and disclose my child's or my health information without my written authorization if they obtain approval through a special process to ensure that research without my written authorization poses minimal risk my child's or my privacy. Under no circumstances, however, would the researchers allow others to use our names or identity us publicly.

The researchers may also disclose my child's or my health information without my written authorization to people who are planning a future research project, so long as any information identifying us does not leave our facility.

Information about people who have died may be shared with researchers using the information of the deceased person, as long as the researchers agree not to remove from our facility any information that identifies these individuals.

CONFIDENTIALITY:
Only the investigator, members of the research team, authorized officials from state and federal governments and authorized representatives from of the Medical College of Georgia or MCG Health Inc. will have access to confidential data which could identify my child or my self, unless specifically required to be disclosed by state or federal law. We will not be identified by name in any report or publications resulting from this study.

AUTHORIZATION TO USE AND DISCLOSE HEALTH INFORMATION:
If I sign this document, I give permission to Dr. Savoca, Dr. Treiber and/or Dr. Harshfield at MCG/MCGHI to use or disclose (release) our health information that identifies us for the research study described above. The researchers may use and share my child's and my protected health information only conduct the research and must remove from my child's and my protected health information any disclosure that could be used to identify my child or me.

The protected health information that the investigator(s) may use or disclose (release) for this research includes:

- From the interviews, information about my child's or my views of hypertension, its causes, and treatment.
- My child's and my blood pressure, weight, and height.

Parent/ Guardian's Initials _____

HAC FILE # 04-04-345
HAC APPROVED INFORMED CONSENT DOCUMENT
APPROVAL FROM 5/10/04 TO 4/24/05.
THIS DOCUMENT IS NO LONGER VALID TO ENROLL SUBJECTS AFTER THIS DATE.

Subject's Name: _____

- The following background information:
  Family history: My child's and my recollection of the history of hypertension (high blood pressure), diabetes, and heart disease of my parents and the parents of my child's father. If any of these family members are deceased, it will include our memory of the cause of death and the age of death.
  Socioeconomic Information: I will be asked to provide my age, education level and the age and educational level of my child's father.
  Academic Performance: The overall average grades of my child.
  Diet History Questionnaire: A history of the foods that we have most often eaten over the past year.

The health information listed above may be used by and/or disclosed to the study's research assistant.

MCG/MCGHI is required by law to protect our health information. By signing this document, I authorize MCG/MCGHI to use and/or disclose our health information for this research. Those people who receive our health information may not be required by Federal privacy law (such as the Privacy Rule) to protect it and may share the information with others without my permission, if permitted by laws governing them.

If all information that does or can identify me or my child is removed from our health information, the remaining information will no longer be subject to this authorization and may be used or disclosed for other purposes.

MCG/MCGHI may not refuse to treat us whether or not I sign this Authorization.

I may change my mind and revoke (take back) this Authorization at any time. Even if I revoke this Authorization, Dr. Savoca may still use or disclose health information they already have obtained about me and my child as necessary to maintain the integrity or reliability of the current research. To revoke this Authorization, I must write to: MCG/MCGHI, Dr. Margaret Savoca, 1120 15th Street, HS-1640, Augusta, GA 30912

This Authorization does not have an expiration date.

I have read this form that serves as an informed consent document and an authorization and have been given the opportunity to ask questions. If I have questions later, I can contact Dr. Savoca at (706) 721-5426. I will be given a signed copy of this document for my records. I authorize the use of my and my child's identifiable information as described in this document.

The risks and benefits to us if we participate in this study have been explained. I am encouraged to and will have the chance to ask questions and these questions will be answered. I voluntarily agree to participate and to authorize the use of our protected health information in this study.

HAC FILE # 04-84-3KS Parent/ Guardian's Initials _____
HAC APPROVED INFORMED CONSENT DOCUMENT
APPROVAL FROM 5/10/04 TO 4/25/05
THIS DOCUMENT IS NO LONGER VALID TO ENROLL SUBJECTS AFTER THIS DATE.

Subject's Name: _____

_____
Subject's Name (print)

_____
* Parent or Guardian's Name (print)

_____ _____
*Parent or Guardian's Signature Date

*The individual above verifies that he/she is the natural parent and/or legal guardian of _____ and as such as has the legal authority to consent to the study outlined above.

_____
Witness' Name (print)

_____ _____
Signature of Witness Date
to the informed consent process and to the signature of the subject and/or subject's parent and/or legal guardian

INVESTIGATOR'S STATEMENT:
I acknowledge that I have discussed the above study with this participant and answered all of his/her questions. They have voluntarily agreed to participate. I have documented this action in the subject's medical record or source document. A copy of this signed document will be placed in the subject's medical record or source document. A copy of this document will be given to the subject or the subject's legally authorized representative.

_____
Printed name of investigator obtaining consent

_____ _____
Signature of investigator obtaining consent Date

HAC FILE # 04-04-345
HAC APPROVED INFORMED CONSENT DOCUMENT
APPROVAL FROM 5/10/04 TO 4/25/05
THIS DOCUMENT IS NO LONGER VALID TO ENROLL SUBJECTS AFTER THIS DATE.

Parent/ Guardian's Initials _____

Young Adult Consent Document

Subject's Name:_____

Georgia Institute for the
Prevention of Human Disease and Accidents
Department of Pediatrics

Subject's Name: _____

YOUNG ADULT CONSENT DOCUMENT

Risk of HTN: Young Adult Lifestyles & Parental Influence

Principal Investigator: Margaret R. Savoca, Ph.D.
Sub-Investigator: Gregory Harshfield, Ph.D.
Frank Treiber, Ph.D.
Conner Evans

INVITATION TO PARTICIPATE:

I have been invited to participate in a research study. This study will look at how young adults and their mothers understand hypertension (high blood pressure) and lifestyle activities, such as eating and exercise. I have been asked to take part in this study because I am African-American between 17-20 years of age, and a past participant in one of Dr. Harshfield's studies at the Georgia Prevention Institute. I will be one of 60 young adults to participate in this study.

PROCEDURES:

If I participate, I would meet with the researcher, Dr. Savoca. This meeting will last about two hours. Dr. Savoca and the research assistant will measure my blood pressure, weight, and height. Then the researcher will take me into a private room to interview me. She will ask me some questions about my views about high blood pressure and its development. She will also ask me about my current and past activities, such as eating and exercise. The interview will take about one hour. In addition to the interview, there will be a questionnaire session that will last one hour. During this time, a research assistant will ask me questions about my family health history and academic grades and complete a diet history questionnaire. At any time during the interview or the questionnaire session, I can refuse to answer any of the questions. Dr. Savoca or the research assistant will skip that question and move to the next topic or question. Similar information will be obtained from my mother. However, none of the information that I provide will be shared with my mother and my mother's information will not be shared with me.

Our interviews with the researcher will be recorded on audio cassette tapes that only Dr. Savoca and the research assistant (RA) will get to hear. At any point during taping, I can

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Subject's Initials _____

Subject's Name:_____

ask that the taping be stopped. The tape recorder will not be turned back on unless I give permission to do so.

Dr. Savoca and the RA will transcribe (write down) all of the information that they collect on each tape. I will not be identified by name in these transcripts. Dr. Savoca will destroy our cassette tapes as soon as she has finished the transcripts. Other researchers will not listen to the tapes or read the transcripts. The transcripts will only be used to learn about how all the young adults and their parents answered the questions. A general summary of the results for all participants will be prepared. Only this general summary will be provided to other researchers.

Sometimes when people are interviewed for a research project, short summaries of the interviews are used to help people understand the results. If the interviews of my mother and me are summarized, any information that might identify us will be changed. That means names, occupations, or events will be changed so that a reader will not recognize us from what is written.

COSTS:
I will be responsible for the costs of transportation to GPI and MCG.

SUBJECT PAYMENT:
I will each receive a $50.00 check in the mail after I complete the interview and the background/diet history questionnaires.

RISKS AND/OR DISCOMFORTS:
There are no risks or discomforts involved in this study. I do not have to answer any questions that make us feel uncomfortable.

POSSIBLE BENEFITS:
I may not personally benefit from this study. My participation in this study may provide important information regarding future prevention and treatment of hypertension in African American teenagers.

ALTERNATIVE TREATMENTS:
The only alternative for this study is to not participate.

COMPENSATION:
While no harm should be expected from my participation in the study, I understand that the Medical College of Georgia assumes no obligation to pay any money or provide free medical care in case this project results in any harm to me.

QUESTIONS:
If I have any questions about the study procedures or about my participation in this study, I may contact Dr. Margaret Savoca at (706) 721-5426. If I have any questions or concerns about the "rights of research subjects", I may contact the Chairman of the Human Assurance Committee, Dr. George S. Schuster at (706) 721-2991.

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Subject's Name:_____

VOLUNTARY PARTICIPATION:
My participation in this study is voluntary. I may revoke my consent and withdraw from the study now or at any time in the future without penalty or loss of care or other benefits to which I am is otherwise entitled. I can do this by telling a member of the study team that I want to stop participating. I understand that my refusal to participate in this study will not prevent me from participating in other studies at this institution.

PRIVACY NOTICE:
The researchers are asking for my written authorization before using my health information or sharing it with others in order to conduct the research described. However, under certain circumstances, the researchers may use and disclose my health information without my written authorization if they obtain approval through a special process to ensure that research without my written authorization poses minimal risk to my privacy. Under no circumstances, however, would the researchers allow others to use my name or identity me publicly.

The researchers may also disclose my health information without my written authorization to people who are planning a future research project, so long as any information identifying me does not leave our facility.

Information about people who have died may be shared with researchers using the information of the deceased person, as long as the researchers agree not to remove from our facility any information that identifies these individuals.

CONFIDENTIALITY:
Only the investigator, members of the research team, authorized officials from state and federal governments and authorized representatives from of the Medical College of Georgia or MCG Health Inc. will have access to confidential data which could identify me, unless specifically required to be disclosed by state or federal law. I will not be identified by name in any report or publications resulting from this study.

AUTHORIZATION TO USE AND DISCLOSE HEALTH INFORMATION:
If I sign this document, I give permission to Dr. Savoca, Dr. Treiber and/or Dr. Harshfield at MCG/MCGHI to use or disclose (release) my health information that identifies me for the research study described above. The researchers may use and share my protected health information only to conduct the research and must remove from my protected health information any disclosure that could be used to identify my child or me.

The protected health information that the investigator(s) may use or disclose (release) for this research includes:

- From the interviews, information about my views of hypertension, its causes, and treatment.
- My blood pressure, weight, and height.
- The following background information:
  Family history: My recollection of the history of hypertension (high blood pressure), diabetes, and heart disease of my parents and my grandparents. If any

Subject's Name:_____

of these family members are deceased, it will include our memory of the cause of death and the age of death.
Academic Performance: The overall average grades during my most recent academic experiences.
Diet History Questionnaire: A history of the foods that I have most often eaten over the past year.

The health information listed above may be used by and/or disclosed to the study's research assistant.

MCG/MCGHI is required by law to protect my health information. By signing this document, I authorize MCG/MCGHI to use and/or disclose my health information for this research. Those people who receive my health information may not be required by Federal privacy law (such as the Privacy Rule) to protect it and may share the information with others without my permission, if permitted by laws governing them.

If all information that does or can identify me is removed from my health information, the remaining information will no longer be subject to this authorization and may be used or disclosed for other purposes.

MCG/MCGHI may not refuse to treat me whether or not I sign this Authorization.

I may change my mind and revoke (take back) this Authorization at any time. Even if I revoke this Authorization, Dr. Savoca may still use or disclose health information they already have obtained about me as necessary to maintain the integrity or reliability of the current research. To revoke this Authorization, I must write to:
MCG/MCGHI, Dr. Margaret Savoca, 1120 15th Street, HS-1640, Augusta, GA 30912

This Authorization does not have an expiration date.

I have read this form that serves as an informed consent document and an authorization and have been given the opportunity to ask questions. If I have questions later, I can contact Dr. Savoca at (706) 721-5426. I will be given a signed copy of this document for my records. I authorize the use of my identifiable information as described in this document.

The risks and benefits to me if I participate in this study have been explained. I am encouraged to and will have the chance to ask questions and these questions will be answered. I voluntarily agree to participate and to authorize the use of my protected health information in this study.

_____
Subject's Name

_____ _____
Subject's Signature Date

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Subject's Initials _____

Subject's Name: _____

_____
Witness' Name (print)

_____ _____
Signature of Witness Date
to the informed consent process and to the
signature of the subject and/or subject's
parent and/or legal guardian

INVESTIGATOR'S STATEMENT:
I acknowledge that I have discussed the above study with this participant and answered all of his/her questions. They have voluntarily agreed to participate. I have documented this action in the subject's medical record or source document. A copy of this signed document will be placed in the subject's medical record or source document. A copy of this document will be given to the subject or the subject's legally authorized representative.

_____
Printed name of investigator obtaining consent

_____ _____
Signature of investigator obtaining consent Date

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Children's Assent Document

Subject's Name: _____

Georgia Institute for the
Prevention of Human Disease and Accidents
Department of Pediatrics

CHILDREN'S ASSENT

Risk of HTN: Young Adult Lifestyles & Parental Influence

Principal Investigator: Margaret R. Savoca, Ph.D.

Sub-Investigator: Gregory Harshfield, Ph.D.
Frank Treiber, Ph.D.
Conner Evans

INVITATION TO PARTICIPATE:
I have been invited to participate in a research study. This study will look at how young adults and their mothers understand hypertension (high blood pressure) and the way that health-related behaviors (like eating and exercise) can help or hurt them. I have been asked to take part in this study because I am an African-American between the ages of 17 to 20 years old who has participated in one of Dr. Harshfield's past studies at the Georgia Prevention Institute. I will be one of 60 young adults to participate in this study.

PROCEDURES:
If I participate in this study then my mother and I will meet with the researcher, Dr. Savoca. This meeting will last about two hours. During this time, the researcher will take my mother into a private room so that she can ask her some questions about blood pressure and lifestyle activities, such as eating and exercise. I will stay in another private room so that a research assistant can ask me some questions about our family background and medical history. I will also fill-out a diet history questionnaire. When the researcher is finished talking with my mother then she will interview me. The researcher will ask me some of the same questions she asked my mother and some that might be different. I should try and be as honest as I can when I answer her questions. I do not need to answer any questions that make me feel uncomfortable. If I do not want to answer a question, I will tell Dr. Savoca and she will ask me the next question. Dr. Savoca will not share my answers with my mother at any time. My mother will wait in the other room while I am with the researcher. She will answer the same questions I did about our family background and medical history. She will also fill-out a diet history questionnaire.

Our interviews with the researcher will be recorded on audio cassette tapes that only Dr. Savoca and the research assistant (RA) will get to hear. At any time, I can ask Dr. Savoca

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to turn the taped recorder off. The tape recorder will not be turned back on unless I tell Dr. Savoca to begin taping again.

Dr. Savoca and the RA will transcribe (write down) all of the information that they collect on each tape. My name will not in these transcripts. Dr. Savoca will destroy our cassette tapes as soon as she has finished the transcripts. No other researchers will listen to the tapes or read the transcripts. The transcripts will only be used to learn about how all the children and their parents answered the questions. One report that describes how the children and their parents answered these questions will be written. Only this report will be read by other researchers.

Sometimes when people are interviewed for a research project, short summaries of their interviews are used to help people understand the results. If my and my mother's interviews are summarized, any information that could identify us will be changed. That means any names, types of jobs, school activities, or family events will be changed so that someone who reads the summary can not tell who are from what is written.

SUBJECT PAYMENT:
I will receive a $50.00 check in the mail after I complete the interview and the diet history questionnaires.

RISKS AND/OR DISCOMFORTS:
There are no risks or discomforts involved in this study. I do not have to answer any questions that make me feel uncomfortable.

POSSIBLE BENEFITS:
I may not personally benefit from this study. My participation in this study may provide important information regarding future prevention and treatment of hypertension in African American teens.

ALTERNATIVE TREATMENTS:
The only alternative for this study is to not participate.

QUESTIONS:
If I have any questions about the study procedures or about my participation in this study, I may contact Dr. Savoca at (706) 721-5426. If I have any questions or concerns about the "rights of research subjects", I may contact the Chairman of the Human Assurance Committee, Dr. George S. Schuster at (706) 721-2991.

VOLUNTARY PARTICIPATION:
I do not have to be in this study. I can stop any time I want to. If I do stop or if I do not want to be in the study, it's okay. No one will be mad at me. I understand that if I decide not to be in this study, I can still be in other studies at MCG if I meet their standards.

I read this paper. They will explain it to me. I will have the chance to ask questions. They will answer the questions so that I can understand. If I have more questions, my parents or I can call Dr. Savoca at (706) 721-5426. I will be in the study.

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Subject's Name: _____

_____
Subject's Name (print)

_____ _____
Subject's Signature Date

_____
* Parent or Guardian's Name (print)

_____ _____
*Parent or Guardian's Signature Date

*The individual above verifies that he/she is the natural parent and/or legal guardian of _____ and as such as has the legal authority to consent to the study outlined above.

_____
Witness' Name (print)

_____ _____
Signature of Witness Date
to the informed consent process and to the signature of the subject and/or subject's parent and/or legal guardian

INVESTIGATOR'S STATEMENT:
I acknowledge that I have discussed the above study with this participant and answered all of his/her questions. They have voluntarily agreed to participate. I have documented this action in the subject's medical record or source document. A copy of this signed document will be placed in the subject's medical record or source document. A copy of this document will be given to the subject or the subject's legally authorized representative.

_____
Printed name of investigator obtaining consent

_____ _____
Signature of investigator obtaining consent Date

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